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**U.S. Department of Navy
Installation Restoration Program**

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RI/FS WORK PLAN

**NAVAL EDUCATION
TRAINING CENTER
NEWPORT, RHODE ISLAND**

**BACKGROUND INVESTIGATION REPORT
FIELD SAMPLING PLAN
QA/QC PLAN
DATA MANAGEMENT PLAN
HEALTH AND SAFETY PLAN**

Prepared for:

Northern Division -
Naval Facilities Engineering Command
Philadelphia, PA

March, 1989

Contract No. N62472-86-C-1282

TTC
**Environmental
Consultants, Inc.**

U.S. DEPARTMENT OF NAVY
Institution Restoration

RI/FS WORK

NAVAL MEDICAL

TRAINING CENTER

NEWPORT, RHODE ISLAND

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ENCLOSURE
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EXECUTIVE SUMMARY

A Remedial Investigation/Feasibility Study (RI/FS) will be conducted by TRC Environmental Consultants, Inc. (TRC) at five sites located at the Naval Education Training Center (NETC) in Newport, Rhode Island. The five sites included in this investigation are the McAllister Point Landfill, Melville North Landfill, Old Fire Fighting Training Area, Tank Farm Four, and Tank Farm Five. The locations of the sites at the NETC are shown on Figure 1. These sites are being studied by the Navy under the Department of Defense Installation Restoration (IR) Program, which is similar to the U.S. EPA's Superfund program authorized under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

The information in this report is presented as a Work Plan consisting of the following five volumes: Background Investigation Report, Field Sampling Plan, Quality Assurance/Quality Control Plan, Data Management Plan, and Health and Safety Plan. A general overview of the contents of each volume is as follows:

- Volume I - Background Investigation Report

Background information on the NETC-Newport facility and the five sites to be studied, including information from previous site investigations performed for the Navy.

- Volume II - Field Sampling Plan

The site-specific sampling plan objectives, sample location and frequency, associated sample analyses, sampling procedures, and sample designations.

- Volume III - Quality Assurance/Quality Control Plan

The quality assurance/quality control procedures for the field sampling activities and laboratory analyses.

- Volume IV - Data Management Plan

The data management procedures which will be used for the control of project documents.

- Volume V - Health and Safety Plan

The site-specific information including characteristics of known wastes, access and work zones, personnel protection and monitoring requirements, personnel and equipment decontamination procedures, and emergency contingency plans.

An introduction to the report is provided which includes a discussion of the overall NETC-Newport investigation data quality objectives and a preliminary identification of potential applicable or relevant and appropriate requirements (ARARs). Subsequent to completion of the Remedial Investigations outlined in this Work Plan, the sample analytical data base will allow the evaluation of public health and environmental risks, consistent with the ongoing risk assessment and feasibility study process under Superfund.

A Feasibility Study (FS) will be performed for sites where remedial response is required based on the risk assessment results. The need for FS efforts at the five sites cannot be determined until the RI field data are collected, and risk assessments conducted in accordance with CERCLA guidance.

Although the need for remedial action at any of the sites has not been fully determined, this Work Plan has identified field data required to begin the FS process. The following general categories of field data are recommended:

- Data required to design containment structures;
- Data required to design run-on/runoff controls; and
- Data required to perform preliminary screening of treatment and removal technologies.

The field investigation activities which will be conducted at the five sites include visual reconnaissance level surveys, ambient air and radiological surveys, geophysical surveys, soil gas surveys, surface soil sampling, subsurface soil sampling, ground water sampling, surface water/sediment/biota sampling, and tank/structure sampling. A summary of the planned field investigation activities is presented in Table 1.

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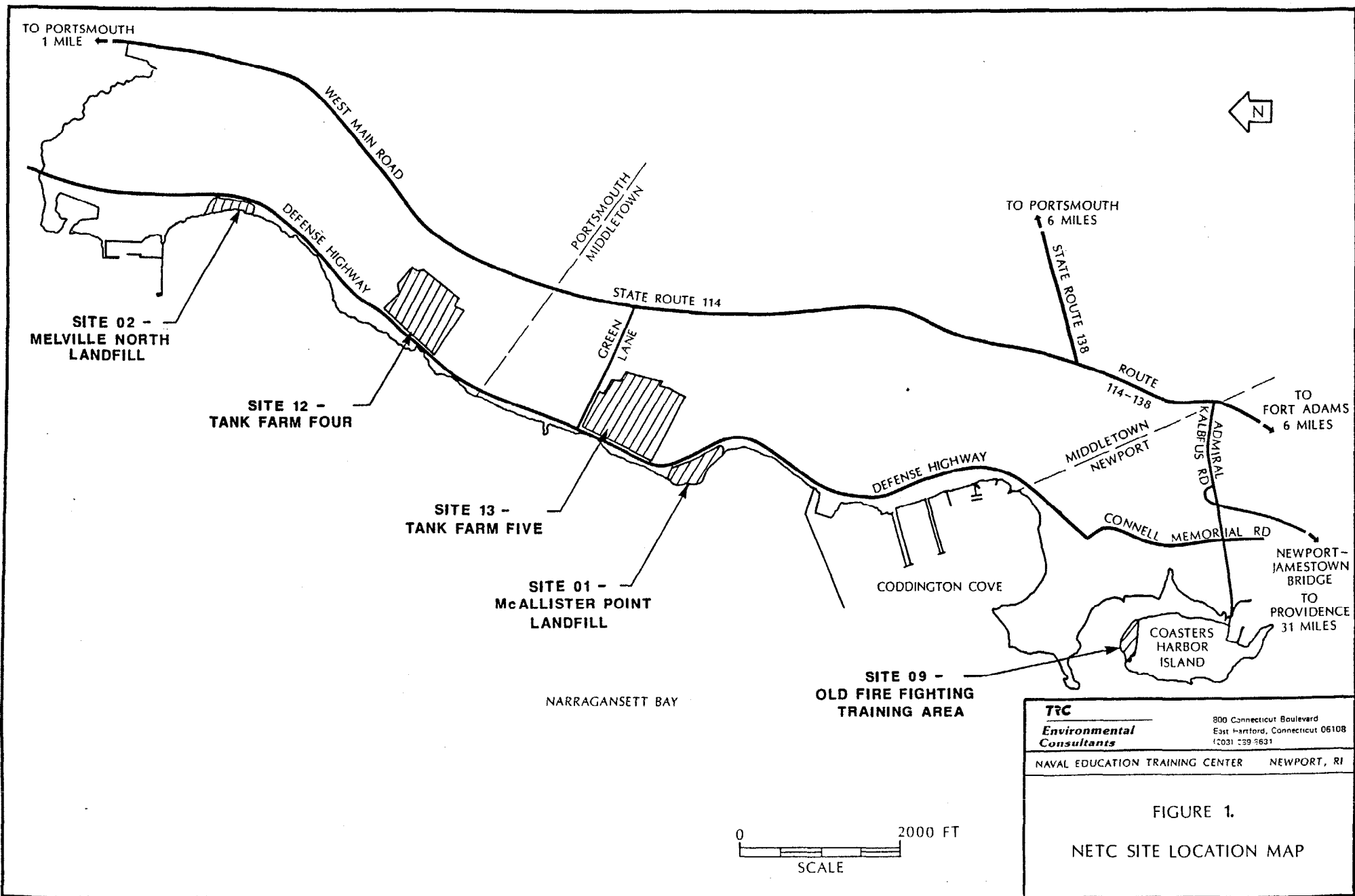


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INTRODUCTION

This section provides an overview of the RI/FS Work Plan for the Naval Education and Training Center in Newport, Rhode Island (NETC-Newport). Additional details of the RI/FS appear in the text provided in Volumes I through V of this Work Plan.

PROGRAM FRAMEWORK

Previous Program Status and Work at NETC-Newport

The NETC-Newport facility has been under assessment through the Department of the Navy's Assessment and Control of Installation Pollutants (NACIP) program. The NACIP program was established to identify and control environmental contamination from past use and disposal of hazardous substances at Navy and Marine Corps installations. The NACIP program is part of the Department of Defense Installation Restoration Program, and is similar to the U.S. EPA's Superfund program authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

The NACIP program consists of three phases:

- Initial Assessment Study (IAS) - consists of records searches and personal interviews to collect and evaluate all evidence supporting the existence of a contamination problem;
- Confirmation Study (CS) - performance of on-site investigations including physical and analytical monitoring to confirm or deny the existence of contamination and, if contamination is present, to quantify the extent of the problem and to recommend necessary remedial measures. The Confirmation Study includes two phases of field data collection - the Verification Step and the Characterization Step.
- Remedial Measures - instituting corrective projects to control and mitigate contamination.

The IAS identifies sites where contamination is suspected to exist and which may pose a health or environmental threat on or off the naval facility. Sites recommended for further investigation during the IAS are addressed in the Confirmation Study. The NETC-Newport IAS was completed in March 1983 by

Envirodyne Engineers, Inc. The first phase of the Confirmation Study, designated the Verification Step, and the second phase, designated the Characterization Step, were completed by Loureiro Engineering Associates in 1983 and 1984-85, respectively.

Current Program Status Work at NETC-Newport

In March 1988, the Navy issued policy guidance which emphasized the Navy's commitment to follow EPA guidance and procedures while conducting investigations and remedial action at hazardous waste sites. This policy pertains to all Navy sites, not just those cited on the National Priorities List (NPL). The March memorandum noted the tasks listed in the current Navy Statement of Work for the Installation Restoration (IR) Program are consistent with EPA guidance and the National Contingency Plan (NCP).

References to the NACIP program have been deleted from current Navy guidance. The Navy calls for the use of EPA guidance documents applicable to CERCLA programs while designing remedial projects under the IR Program Statement of Work.

SCOPE OF WORK

The scope of work for this Work Plan was delineated in Amendment 00004 to the subject contract (N62472-86-C-1282) between the Navy and TRC, dated March 9, 1988. The scope of work, and TRC's proposal, called for developing a Plan of Action which follows EPA guidance for RI/FS Work Plans.

This current project entails the initial planning phase of the RI/FS process, and includes four RI/FS scoping tasks under the Navy IR Program; i.e.:

- Task R1 - Description of Current Situation;
- Task R2 - Development of Plans and Management, i.e., Field Sampling Plan; QA/QC Plan; Data Management Plan; and Health and Safety Plan;

The scope of this RI/FS Work Plan includes the following activity for five sites at NETC-Newport:

- Collect existing data, including previous investigations such as the IAS (Envirodyne, 1983) and the Confirmation Study (Loureiro, 1986);
- Identify study boundary areas for each site;
- Begin identification of applicable or relevant and appropriate requirements (ARARs);
- Identify remedial action objectives and likely remedial action alternatives;
- Establish data quality objectives; i.e., specify data needed to support decisions regarding remedial actions;
- Prepare the Field Sampling Plan (FSP); Quality Assurance/Quality Control (QA/QC) Plan; Data Management Plan; and Health and Safety Plan (HASP).

BACKGROUND INVESTIGATION REPORT - VOLUME I

The Background Investigation Report for the NETC-Newport remedial investigation is provided in Volume I of this Work Plan. This report presents background information on the NETC-Newport facility and the five sites included in this investigation. Specifically, the Background Investigation Report is based upon a compilation of information obtained from previous site investigation reports. The report contains information on two main subjects: the background for the base and each site, and the history of response actions at each site. The background discussion addresses the physiography, geology, and hydrology for the base and each site. The history of response actions discussion addresses the history of the NETC environmental program and the results of the Initial Assessment Studies, Confirmation Studies, and other investigations performed at the sites.

FIELD SAMPLING PLAN - VOLUME II

The Field Sampling Plan (FSP) for the NETC-Newport remedial investigation is presented in Volume II of this Work Plan. The FSP development was based on an evaluation of data requirements, and comparison to existing data. The data required to thoroughly assess health and environmental impacts of each site was the driving force for developing this plan. Data requirements to begin

the Feasibility Study (FS) process were a second factor considered in developing this plan.

Sampling and analytical procedures have been selected to meet EPA guidance and requirements of the CERCLA program. All of the proposed sampling procedures appear in the Field Sampling Plan. Analytical procedures are presented in the Quality Assurance/Quality Control Plan in Volume III of this Work Plan.

QUALITY ASSURANCE/QUALITY CONTROL PROJECT PLAN - VOLUME III

The Quality Assurance/Quality Control (QA/QC) Plan prepared for the NETC-Newport remedial investigation is provided in Volume III of this Work Plan. The QA/QC Plan is consistent with the U.S. EPA's format requirements for a 16-element plan. The QA/QC Plan also meets appropriate NEESA guidance dated June 1986, entitled "Sampling and Chemical Analysis Quality Assurance Guide for Navy Assessment and Control of Installation Pollutants (NACIP) Program" (NEESA 20.2-047A). As required, the Navy has provided advance copies of select information from the draft revision to this NEESA guidance, dated June, 1988. Much of the information in the QA/QC Plan reflects the procedures used by analytical laboratories under the U.S. EPA Contract Laboratory Program (CLP).

The QA/QC Plan describes procedures for field sampling and laboratory analyses, including quality control procedures. The QA/QC Plan is based on the following documents:

- TRC Corporate Quality Assurance Program;
- a CLP laboratory QA/QC Plan, previously approved by NEESA;
- EPA - Contract Laboratory Program (CLP) analytical methods; and
- EPA-approved methods, as referenced in the QA/QC Plan.

DATA MANAGEMENT PLAN - VOLUME IV

The Data Management Plan prepared for the NETC-Newport remedial investigation is provided in Volume IV of this Work Plan. The plan builds on

procedures currently in use at TRC and CLP laboratories. The Data Management Plan addresses requirements of the Navy IR program, as well as EPA's CERCLA program. The goal of the plan is to ensure all data developed during the RI is accurately reproduced in the final report, fully documented and traceable, and able to withstand judicial review, if necessary.

Key elements of the Data Management Plan address the following items:

- Project file organization and custody (document control);
- Field data collection, recording, and maintenance;
- Sample chain-of-custody documentation;
- Analytical laboratory results;
- QA/QC Plan data and audits;
- Project cost and schedule control including subcontractors (i.e., laboratory, drillers); and
- Reporting requirements, including RI report outline.

HEALTH AND SAFETY PLAN - VOLUME V

The Health and Safety Plan (HASP) prepared for the NETC-Newport remedial investigation is provided in Volume V of this Work Plan. The HASP was developed to establish baseline mandatory guidelines and requirements for the safety of all field personnel. The HASP builds on the TRC Corporate Health and Safety Program which was developed in accordance with all applicable requirements (i.e., OSHA 29 CFR 1910.120; CERCLA 111(c)(6); and SARA Section 126(d)).

The HASP describes the following elements for each site being investigated at NETC-Newport: wastes known to be present, site access, site work zones, personal protection requirements, monitoring for worker protection, decontamination procedures for personnel and equipment, and contingency plans to handle site emergencies. The NETC-Newport HASP will be implemented at the sites by an On-scene Safety Coordinator (OSC). Compliance with the HASP will be monitored by the TRC Corporate Health and Safety Director, who may perform optional field safety program compliance audits.

No site work will be performed until the HASP is approved by the Northern Division, as well as the TRC Corporate Health and Safety Director. TRC requires all subcontractors to have health and safety programs for their employees, and to implement site-specific HASPs which meet requirements of the TRC Corporate Program.

DATA QUALITY OBJECTIVES

The focus of the data quality objectives for the NETC-Newport investigations center around risk assessment requirements. A second objective is to collect field data useful for screening of remedial alternatives, should feasibility studies be required for the sites.

Data Requirements for Risk Assessment

A preliminary risk assessment was performed for several of the sites in the Confirmation Study (Loureiro, 1986). The analytical data collected during the Confirmation Study was sufficient for conducting a preliminary screening of several of the sites in terms of potential adverse effects on public health and the environment. Additional analytical data are required for all five sites so that risk/endangerment assessments can be performed consistent with current EPA guidance (as outlined in the Superfund Public Health Evaluation Manual (U.S. EPA, 1986)). Sampling and analysis of appropriate media have been proposed in this Work Plan to supplement previous site investigation results, thus allowing for the performance of such an assessment.

The Work Plan proposes additional surface soil sampling, subsurface soil sampling, tank/structure sampling, ground water sampling, and surface water media sampling to assess the associated contamination exposure risks to the public and environment. Subsequent to completion of the remedial investigations outlined in this Work Plan, the sample analytical data base will allow the evaluation of public health and environmental risks, consistent with the current risk assessment and feasibility study process under Superfund.

Feasibility Studies

A Feasibility Study (FS) will be performed for each site where remedial response is required based on risk assessment results. The need for FS efforts at the five sites cannot be determined until the RI field data are

collected, and risk assessments conducted in accordance with CERCLA guidance. For this reason, current CERCLA guidance calls for a phased RI approach. This approach allows collection of additional, more detailed field data if initial data collection indicates remedial response is appropriate.

Although the need for remedial actions at any of the sites has not been fully determined, this Work Plan has identified field data required to begin the FS process. The following general categories of field data are recommended:

- Data required to design containment structures;
- Data required to design runoff/runoff controls; and
- Data required to perform preliminary screening of treatment and removal technologies.

In the event that the results of the RI described in this Work Plan suggest that any of the sites represents a major contamination source, more extensive field data may be required to adequately address a broader range of remedial technologies.

ARARs AND PRELIMINARY REMEDIAL ACTION ALTERNATIVES

Applicable or Relevant and Appropriate Requirements

The Superfund Amendments and Reauthorization Act (SARA) and the NCP require that all remedial response actions adhere to Applicable or Relevant and Appropriate Requirements (ARARs). The NCP defines applicable requirements as Federal requirements that would apply if the remedial action was not driven by CERCLA. Relevant and appropriate requirements are defined in the NCP as Federal requirements designed to apply to problems similar to those at the site.

Current EPA CERCLA guidance calls for a preliminary identification of potential ARARs during the RI scoping phase to assist in initial identification of remedial alternatives. Early identification also facilitates communication with support agencies to evaluate ARARs, and may help in the planning of field activities. Because of the iterative nature of

the RI/FS process, ARAR identification continues throughout the RI/FS as better understanding is gained of site conditions, site contaminants, and remedial action alternatives.

ARARs may be categorized in three ways: as contaminant-specific, which may define acceptable exposure levels and, therefore, be used in establishing preliminary cleanup goals; as location-specific, which may set restrictions on activities within specific locations such as flood plains or wetlands; and as action-specific, which may set controls or restrictions for particular treatment and disposal activities related to the management of hazardous wastes. The document, "Guidance on CERCLA Compliance With Other Statutes" (U.S. EPA, July 1987 Draft), contains detailed information on identifying and complying with ARARs.

Both Federal and State of Rhode Island ARARs will be addressed while conducting this RI/FS. A preliminary list of ARARs which will be investigated is provided in Figure 1. The State of Rhode Island ARARs listed in Figure 1 will be further identified through discussions with the Rhode Island DEM when the RI/FS begins.

Preliminary Remedial Action Alternatives

EPA's CERCLA guidance calls for the identification of potential remedial action objectives for each contaminated medium. Candidate technologies are also identified to help ensure data needed to conduct the technical evaluation of the technologies can be collected as early as possible during the RI/FS. Early identification of potential technologies also helps determine whether treatability studies may be required during the RI. The approach to conducting a feasibility study is shown in Figure 2.

EPA guidance calls for identifying a list of remedial action alternatives during the RI/FS in order to present a range of remedial options to the decision-maker. The list should include: 1) treatment alternatives to reduce the toxicity, mobility, or volume of waste, 2) one or more alternatives that involve containment with little or no treatment, and 3) a no-action alternative. Current EPA guidance additionally suggests that the list should be limited to alternatives that are relevant to the site(s) and carry some

significant potential for being implemented at the site. Innovative technologies and resource recovery options should be included if they appear feasible.

General response actions that may be taken at the five sites being investigated in this RF/FS have been identified during an initial scoping exercise (see Table 1). These responses will be refined throughout the RI as a better understanding of site conditions is gained and action-specific ARARs are identified. Based on an evaluation of apparent site-specific problems and the proposed cleanup criteria, a master list of potentially feasible remedial technologies has also been developed. The cleanup methods include both on-site and off-site remedies and include treatment technologies to the maximum extent practicable to permanently reduce contaminant toxicity, mobility, and volume.

A list of potential remedial technologies is presented in Table 2 as adopted from the EPA "Guidance on Feasibility Studies Under CERCLA" (U.S. EPA, 1985). These technologies are listed in addition to the no action and institutional control general response action technologies. The list of remedial technologies is all-inclusive. Based on site and waste characteristics that may affect remedial technology selection, a screening process will be conducted and technologies that may prove extremely difficult or timely to implement, or rely on an insufficiently developed technology, will be eliminated from further consideration. To reduce this list to a usable number of technologies with which to form remedial strategies, a screening procedure, which conforms with the procedures and criteria specified in the EPA document "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (U.S. EPA, 1988) will then be implemented. The screening eliminates technologies if they: (1) have not been proven reliable in applications to the contaminants of concern; or (2) are not considered feasible based on the waste characteristics, media impacted, contaminant concentrations, or specific site conditions. Specific reasons for eliminating technologies will be tabulated in the FS report. Innovative technologies are carried through the screening process if there is a reasonable belief that they offer potential for better treatment performance or implementability, few or lesser adverse impacts than other available

TABLE 1

GENERAL RESPONSE ACTIONS FOR NETC-NEWPORT SITES

Operable Unit	General Response Actions
Soil/Waste	<ul style="list-style-type: none">• No Action• Institutional Control• Containment• Source Removal• Off-site Disposal• On-site Treatment• Off-site Treatment• In Situ Treatment
Ground Water	<ul style="list-style-type: none">• No Action• Institutional Control• Containment• Collection• On-site Treatment• Off-site Treatment• In Situ Treatment• Off-site Treatment
Surface Water	<ul style="list-style-type: none">• No Action• Institutional Control• Collection• Diversion• On-site Treatment• Off-site Treatment
Sediment	<ul style="list-style-type: none">• No Action• Institutional Control• Containment• Source Removal• Off-site Disposal• On-site Treatment• Off-site Treatment• In Situ Treatment

TABLE 2
REMEDIAL TECHNOLOGIES

-
- A. CONTAINMENT
- Capping/Surface Sealing
 - Clay
 - Synthetic membrane
 - Asphalt
 - Concrete
 - RCRA multimedia
 - Chemical sealants/stabilizers
- B. GRADING
- Scarification
 - Tracking
 - Contour furrowing
- C. REVEGETATION
- Grasses
 - Legumes
 - Shrubs
 - Trees, conifers
 - Trees, hardwoods
- D. SURFACE WATER DIVERSION AND COLLECTION STRUCTURES
- Dikes and berms
 - Ditches, diversions and waterways
 - Terraces and benches
 - Chutes and downpipes
 - Levees
- E. LEACHATE AND GROUND WATER CONTROLS
- Capping (see A)
 - Containment barriers
 - Function Options
 - Downgradient placement
 - Upgradient placement
 - Circumferential placement
 - Material and Construction Options (Vertical Barriers)
 - Soil-bentonite slurry wall
 - Cement-bentonite slurry wall
 - Vibrating beam
 - Grout curtains
 - Steel sheet piling
 - Horizontal Barriers (Bottom Sealing)
 - Block displacement
 - Grout injection
-

(Continued)

TABLE 2
REMEDIAL TECHNOLOGIES
(Continued)

F. COLLECTION

- Extraction/Ground Water Pumping (Generally used with capping and treatment)
 - Function Options
 - Extraction and injection
 - Extraction alone
 - Injection alone
 - Equipment and Material Options
 - Well points
 - Deep wells
 - Suction wells
 - Ejector wells
 - Subsurface Collection Drains
 - French drains
 - Tile drains
 - Pipe drains (dual media drains)

G. EXCAVATION AND REMOVAL OF WASTE AND SOIL

- Excavation and removal
 - Backhoe
 - Cranes and attachments
 - Front end loaders
 - Scrapers
 - Pumps
 - Industrial vacuums
 - Drum grapplers
 - Forklifts and attachments
- Grading (see B)
- Capping (see A)
- Revegetation (see B)

H. REMOVAL AND CONTAINMENT OF CONTAMINATED SEDIMENTS

- Sediment removal
 - Mechanical dredging
 - Clamshell
 - Dragline
 - Backhoe
 - Hydraulic dredging
 - Plain suction
 - Cutterhead
 - Dustpan
 - Pneumatic dredging
 - Airlift
 - Pneuma
 - Oozer
-

(Continued)

TABLE 2

(Continued)

H. REMOVAL AND CONTAINMENT OF CONTAMINATED SEDIMENTS (Continued)

- Sediment turbidity controls and containment
 - Curtain barriers
 - Cofferdams
 - Pneumatic barriers
 - Capping

I. GAS MIGRATION CONTROLS (generally used with treatment)

- Capping (gas barriers)(see A.)
- Gas collection and/or recovery
 - Passive pipe vents
 - Passive trench vents
 - Active gas collection systems

J. IN SITU TREATMENT

- Hydrolysis
- Oxidation
- Reduction
- Soil aeration
- Solvent flushing
- Neutralization
- Polymerization
- Sulfide precipitation
- Bioreclamation
- Permeable treatment beds
- Chemical dechlorination
- Vacuum extraction

K. DIRECT WASTE TREATMENT

- Incineration
 - Rotary Kiln
 - Fluidized bed
 - Multiple hearth
 - Liquid injection
 - Molten salt
 - High temperature fluid wall
 - Plasma arc pyrolysis
 - Cement kiln
 - Infrared
 - Pyrolysis/starved combustion
 - Wet air oxidation
 - Industrial boiler or furnace
 - Gaseous waste treatment
 - Activated carbon
 - Flares
 - Afterburners
-

(Continued)

TABLE 2
(Continued)

K. DIRECT WASTE TREATMENT (Continued)

- Treatment of aqueous and liquid waste streams
 - Biological treatment
 - Activated sludge
 - Trickling filters
 - Aerated lagoons
 - Waste stabilization ponds
 - Rotating biological disks
 - Fluidized bed bioreactors
 - Chemical Treatment
 - Neutralization
 - Precipitation
 - Oxidation
 - Hydrolysis
 - Reduction
 - Chemical dechlorination
 - Ultraviolet/ozonation
 - Physical Treatment
 - Flow equalization
 - Flocculation
 - Sedimentation
 - Activated carbon
 - Kleensorb
 - Ion exchange
 - Reverse osmosis
 - Liquid-liquid extraction
 - Oil-water separator
 - Steam distillation
 - Air stripping
 - Steam stripping
 - Filtration
 - Dissolved air flotation
 - Discharge to a publicly owned treatment works
 - Solids handling and treatment
 - Dewatering
 - Screens, hydraulic classifiers, scalpers
 - Centrifuges
 - Gravity thickening
 - Flocculation, sedimentation
 - Belt filter presses
 - Filter presses
 - Drying or dewatering beds
 - Vacuum-assisted drying beds
 - Treatment
 - Neutralization
 - Solvent
 - Oxidation
 - Reduction
 - Composting
-

(Continued)

TABLE 2

(Continued)

K. DIRECT WASTE TREATMENT (Continued)

- Solidification, stabilization, or fixation
 - Cement-based
 - Lime-based
 - Organic polymer
 - Self-cementing techniques
 - Surface encapsulation
 - Glassification
 - Solidification (i.e., to fly ash, polymers, sawdust)

L. LAND DISPOSAL/STORAGE

- Landfills
 - Surface impoundments
 - Land application
 - Waste piles
 - Deep well injection
 - Temporary storage
-

approaches, or lower costs than demonstrated technologies. The technologies which pass the screening process are then described in more detail, prior to the initial formulation of remedial action alternatives.

FIGURES

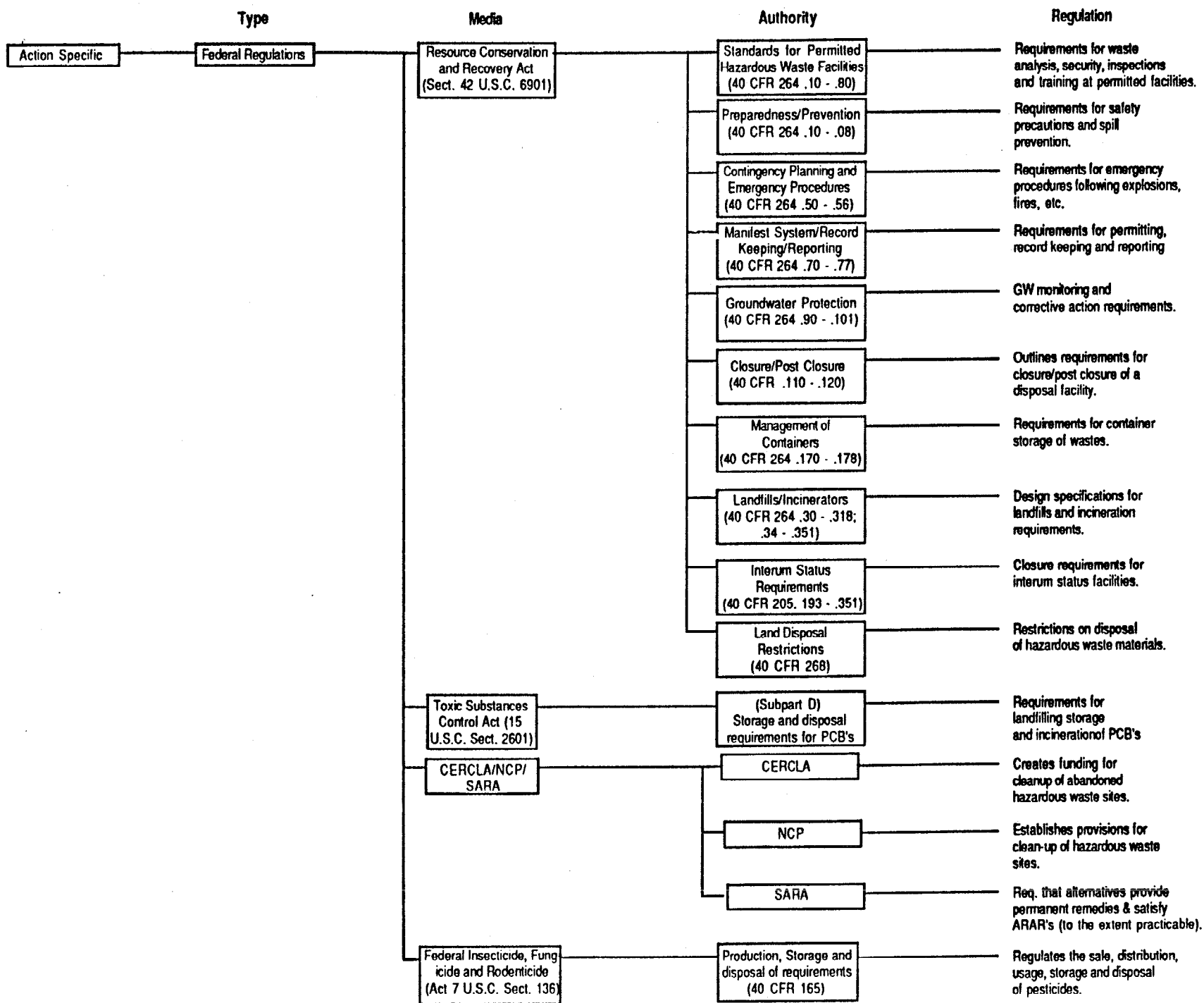


FIGURE 1. PRELIMINARY IDENTIFICATION OF ARAR's FOR NETC - NEWPORT (1 of 5)

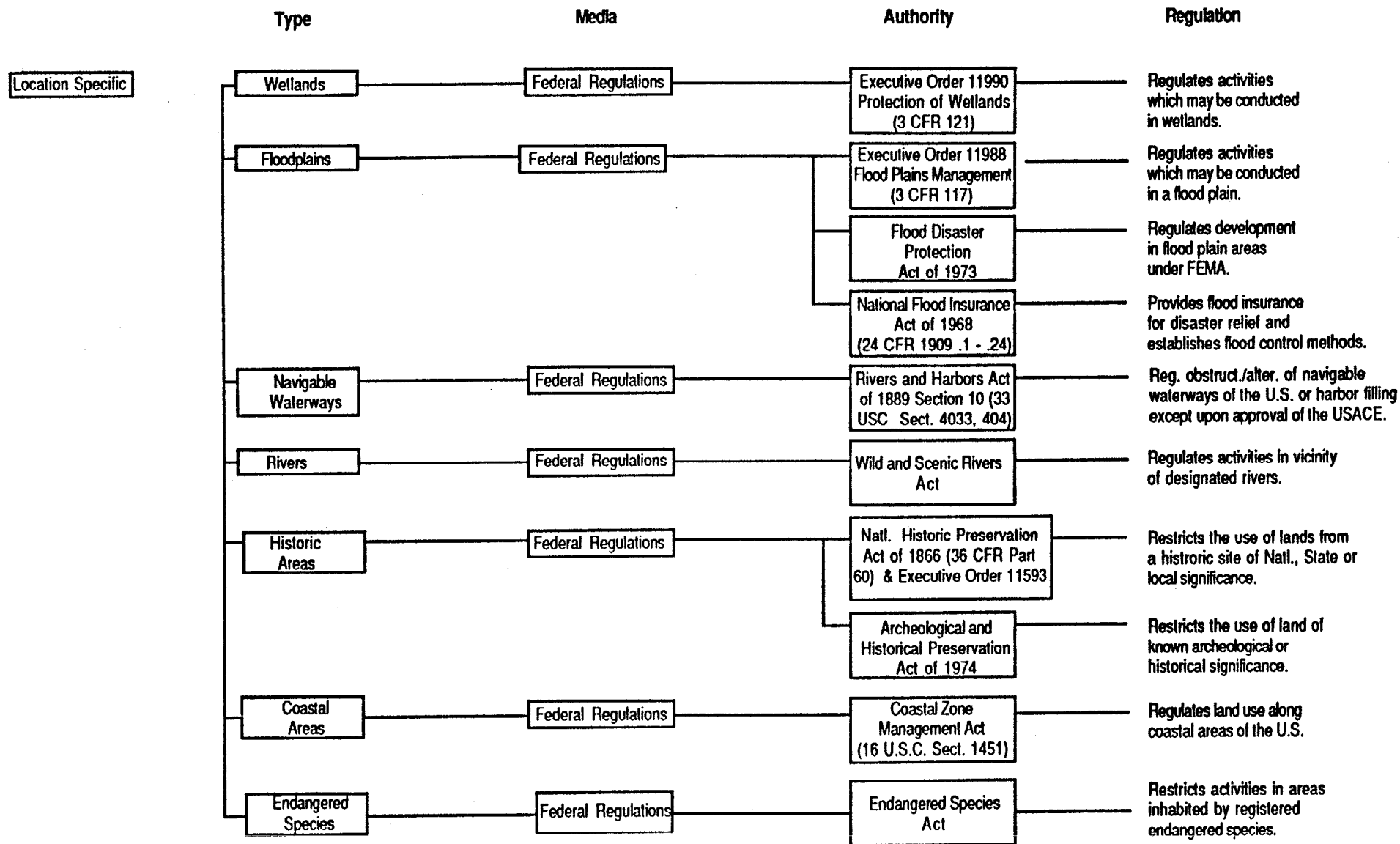


FIGURE 1. (continued) (2 of 5)

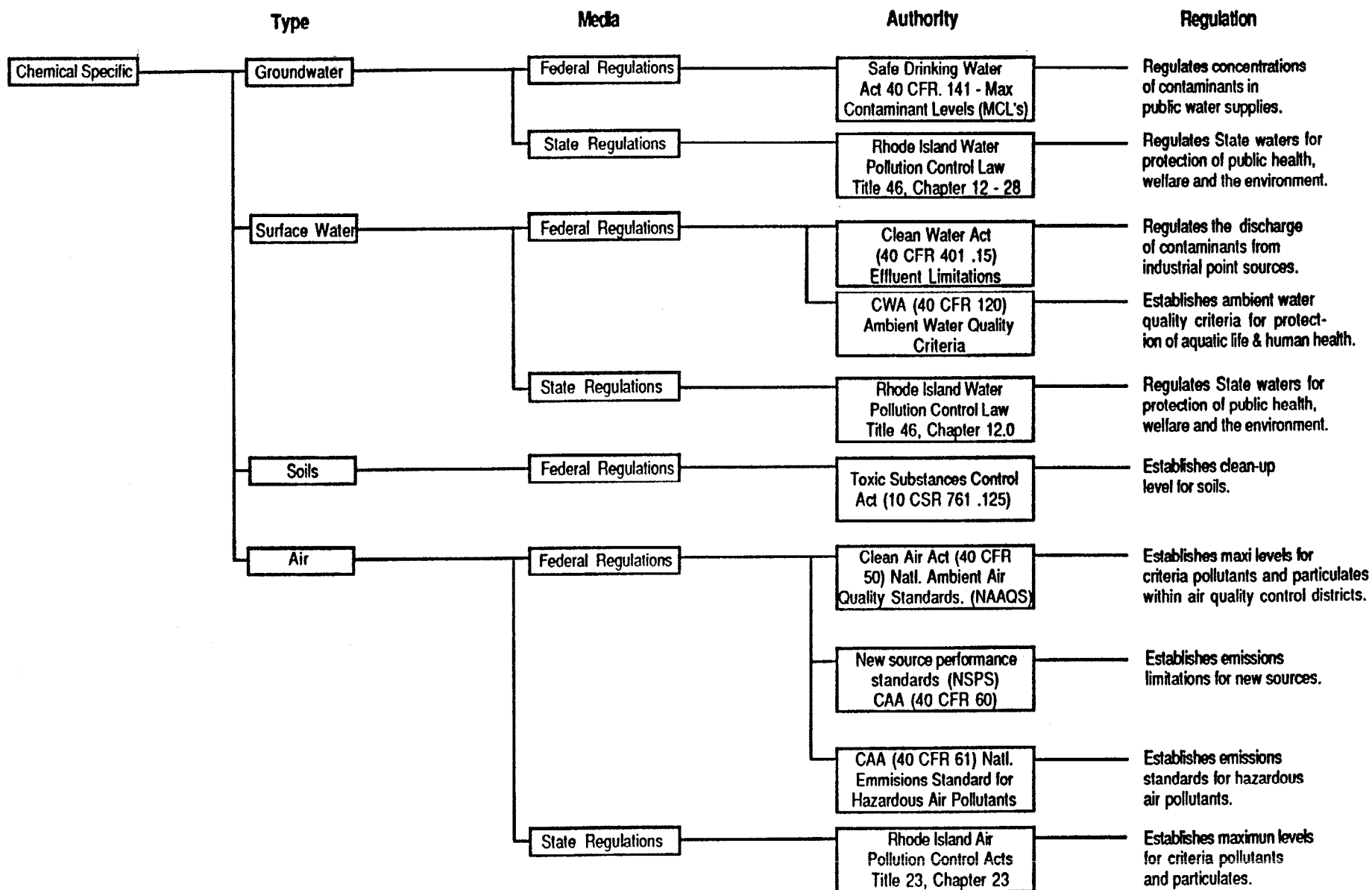


FIGURE 1. (continued) (3 of 5)

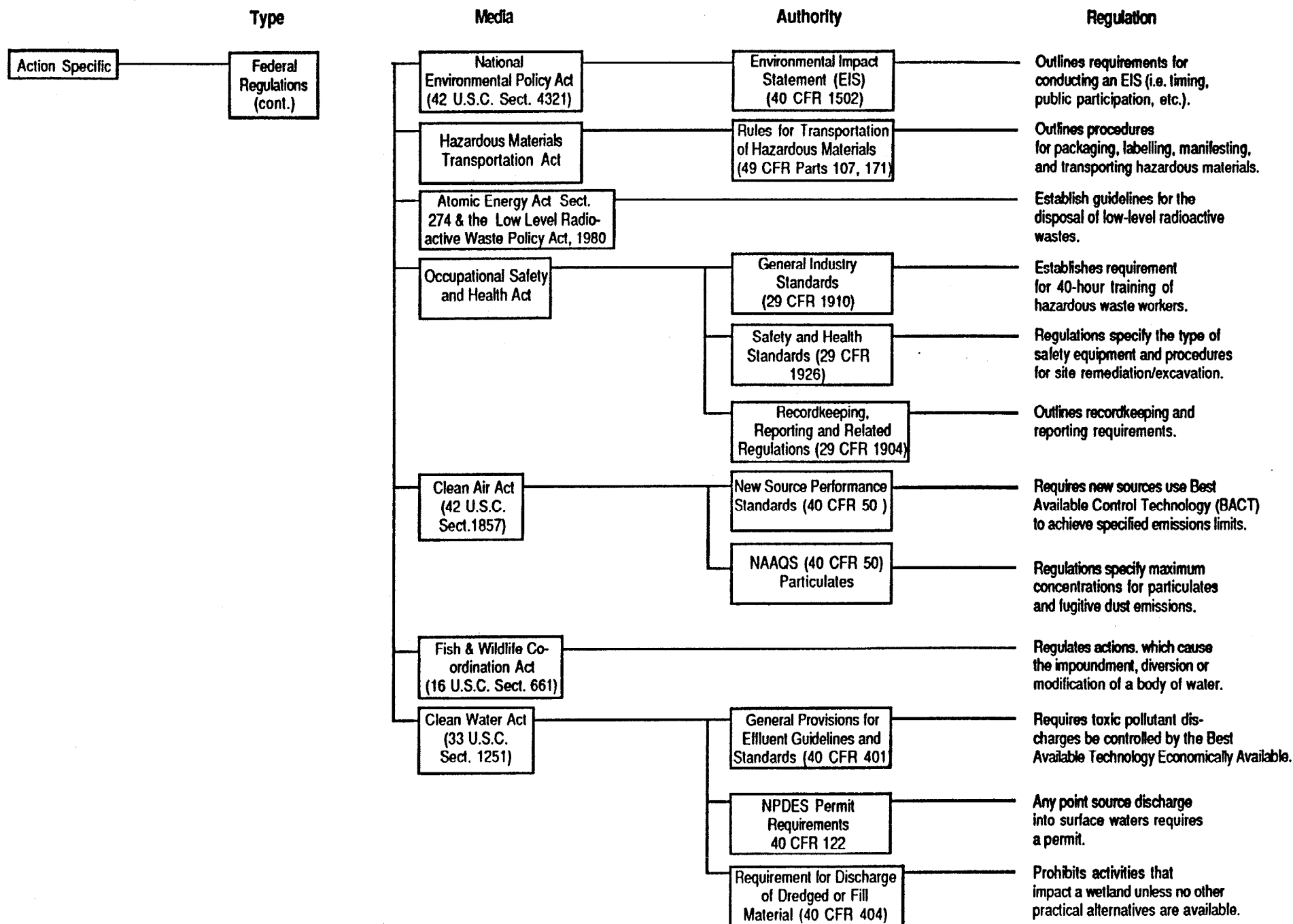


FIGURE 1. (continued) (4 of 5)

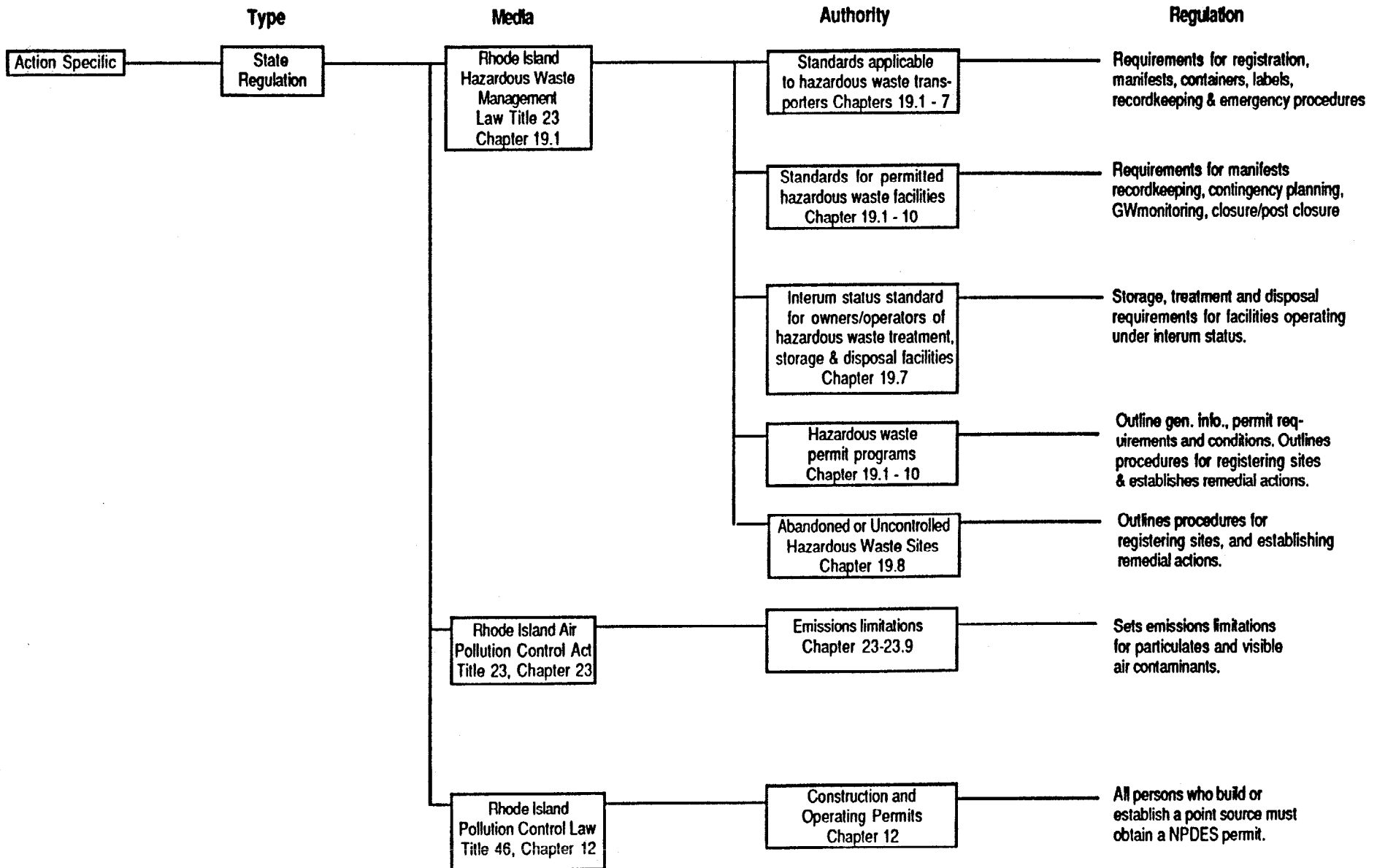


FIGURE 1. (continued) (5 of 5)

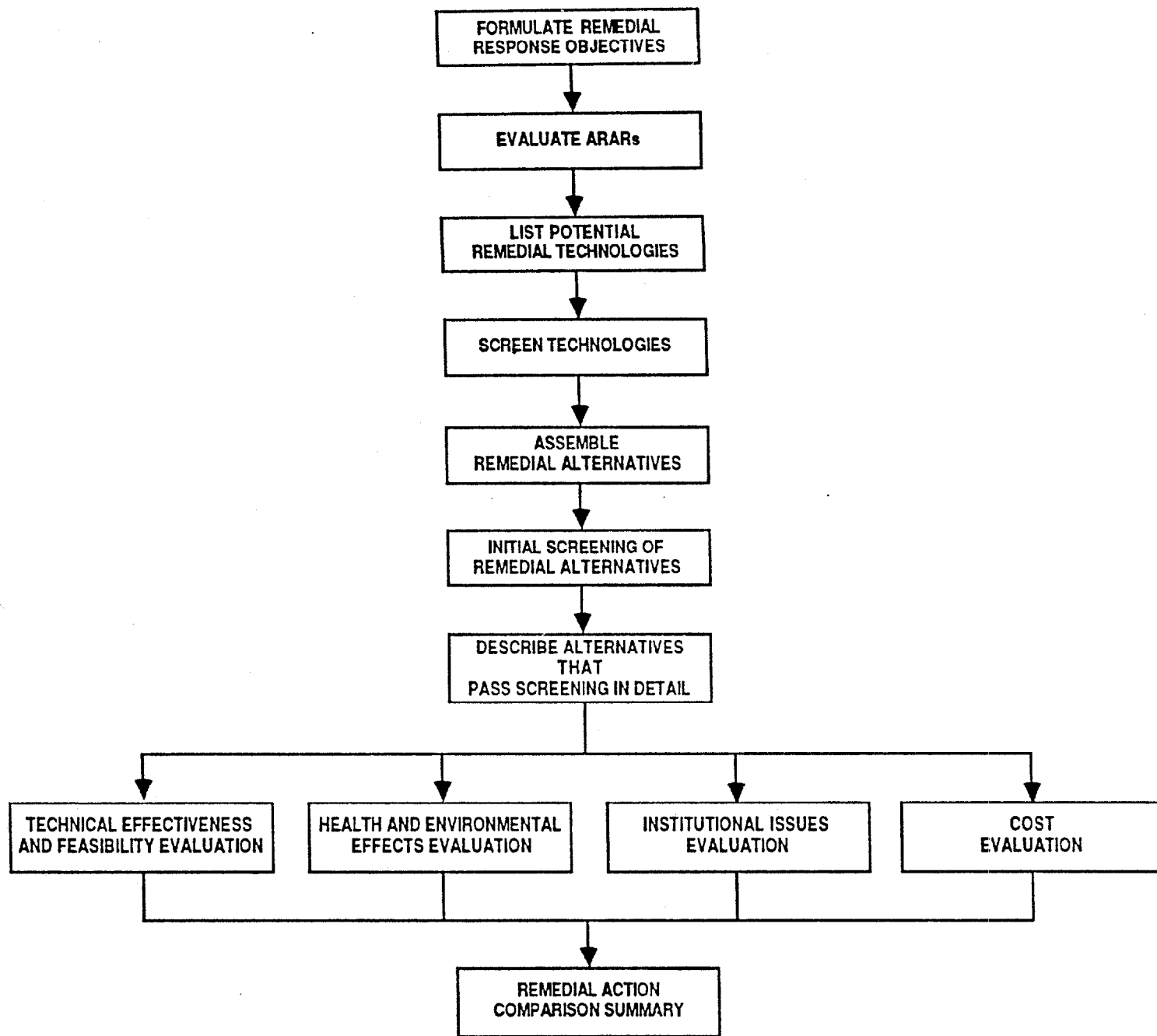


FIGURE 2. FEASIBILITY STUDY APPROACH

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

RI/FS WORK PLAN
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared for:

Northern Division - Naval Facilities
Engineering Command
Philadelphia, PA

VOLUME I
BACKGROUND INVESTIGATION REPORT

March 1989

TRC Project No. 5383-N81-10
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1.0 INTRODUCTION

This report of the current situation at the Naval Education and Training Center (NETC) in Newport, Rhode Island, is submitted in partial fulfillment of Task R1 of the Remedial Investigation and Feasibility Study (RI/FS). The RI/FS is being conducted under contract N62472-86-C-1282 for the NORTHNAVFACENGCOM. TRC Environmental Consultants, Inc. (TRC) was authorized to begin work on Tasks R1 and R2 (Plan of Action) on August 25, 1988.

Two earlier phases of the Installation Restoration (IR) Program were performed by others. An Initial Assessment Study (IAS) was conducted by Envirodyne Engineers, Inc., St. Louis, Missouri, on sixteen potential hazardous waste sites at the NETC. This was followed by a Confirmation Study (CS) conducted by Loureiro Engineering Associates, Avon, Connecticut, on six sites judged to require further study. A summary of all hazardous waste sites investigated at the NETC is presented in Table 1. The studies conducted at each site and the current plan of action for each site are also presented in Table 1. This RI/FS is the third phase of the four-part IR Program (Remedial Action (RA) Plan is the fourth phase). This RI/FS addresses the following five sites:

- Site 01 - McAllister Point Landfill
- Site 02 - Melville North Landfill
- Site 09 - Old Fire Fighting Training Area
- Site 12 - Tank Farm Four
- Site 13 - Tank Farm Five

The numbers for these five sites were assigned during the IAS and have been retained for this investigation for consistency and to avoid confusion. Only three of the above sites, McAllister Point Landfill, Melville North Landfill, and Tank Farm 4, were investigated in both the IAS and CS. Tank Farm 5 was studied in the IAS, and tank numbers 53 and 56 at the site were extensively studied as part of a tank closure plan. The Fire Fighting Training Area site has not been sampled or extensively studied previously.

In April 1973, the Shore Establishment Realignment Program (SER) resulted in drastic reductions in Navy personnel at the Newport base and initiated the process of excessing (selling) large portions of the base's real estate. The only site being addressed in this RI/FS that is not in the process of being

TABLE 1

SUMMARY OF NETC HAZARDOUS WASTE SITES

No.	Site	Characteristics/Studies/Plan of Action
1	McAllister Point Landfill	<u>1955 - 1970s</u> - The landfill received all waste generated at the Newport Naval Complex. This site contains wastes from operation (machine shops, electroplating, etc.), Navy housing, and ships homeported in Newport. Materials disposed of at this site would be mostly domestic-type refuse but also include spent acids, paints, solvents, waste oils (lube, diesel, and fuel), and PCB-contaminated oil. An IAS and CS were conducted of the site. Site will be investigated under the current RI/FS.
2	Melville North Landfill	<u>WWII - 1955</u> - The landfill received mostly domestic-type refuse and also spent acids, waste paints, solvents, waste oils, and PCBs. Several areas are covered with oil and oily sludge on the site. The site has been excessed and is owned by Melville Marine Industries. An IAS and CS were conducted of the site. Site will be investigated under the current RI/FS.
3	Structure #214 - Melville North	<u>1980 - 1982</u> - Substation #214. The site has been excessed. NETC cleaned the site under a removal action.
4	Coddington Cove Rubble Fill	<u>1978 - 1982</u> - Rubble dump which contains inert items including scrap lumber, tires, wire, cable, and empty paint cans. An IAS conducted of the site recommended no further action.
5	Melville North Area	<u>1978 - 1982</u> - Twenty barrels of waste oil stored on an asphalted area. Oil was spilled in the area. The site has been excessed. An IAS was conducted of the site. NETC cleaned the site under a removal action.
6	STP Sludge Drying Bed	<u>1982 - 1983</u> - Site is located in Melville North at the old sewage treatment plant. Oily waste has been disposed of at this site. Site has been excessed. An IAS was conducted of the site. NETC cleaned the site under a removal action.

TABLE 1
SUMMARY OF NETC HAZARDOUS WASTE SITES
(Continued)

No.	Site	Characteristics/Studies/Plan of Action
7	Tank Farm #1	<u>WWII - 1970</u> - Located in Melville North. Contains six 60,000-barrel underground storage tanks (USTs) for diesel oil, fuel oil, jet fuel, 100 octane gasoline, and aviation fuel. Tank bottom sludge generated from cleaning the tanks was placed in on-site pits. Approximately 6,000 gallons of sludge was disposed of at the site. An IAS and CS were conducted of the site. The performance of an RI/FS is dependent upon the results of the RI/FS conducted at two other tank farms (Sites 12 and 13).
8	NUSC Disposal Area	<u>Early 1970s</u> - Located in Coddington Cove. Contains rubble, inert materials including scrap lumber, tires, wire, cable, and empty paint cans. An IAS conducted on the site recommended no further action.
9	Old Fire Fighting Training Area	<u>WWII - 1972</u> - Located on Coaster's Harbor Island. Waste oils were used at the site to train personnel in fire fighting operations. Site has been excavated to remove contaminated soils. An IAS conducted of the site recommended no further action. Oil discovered at the site during a recent geotechnical investigation for the expansion of an operating facility on the site indicated the need for further investigation of the site. The site will be investigated under the current RI/FS.
10	Tank Farm #2	<u>WWII - 1970</u> - Located in Melville. Contains eleven 60,000-barrel USTs for fuel. Approximately 100,000-175,000 gallons of sludge were disposed in on-site pits. An IAS was conducted of the site. The performance of an RI/FS is dependent upon the results of the RI/FS conducted at two other tank farms (Sites 12 and 13).
11	Tank Farm #3	<u>WWII - 1970</u> - Located in Melville. Contains seven 60,000-barrel USTs for fuel. Tank sludge bottoms were disposed in burning chambers. The burning chambers had steel sides and sand bottoms. An IAS was conducted on the site. The performance of an RI/FS is dependent upon the results of the RI/FS conducted at two other tank farms (Sites 12 and 13).

TABLE 1
SUMMARY OF NETC HAZARDOUS WASTE SITES
(Continued)

No.	Site	Characteristics/Studies/Plan of Action
12	Tank Farm #4	<u>WWII - 1970</u> - Located in Melville. Contains twelve 60,000-barrel USTs for fuel. Approximately 100,000-190,000 gallons of tank sludge bottoms were disposed of on-site. An IAS and CS were conducted of the site. Site will be investigated under the current RI/FS.
13	Tank Farm #5	<u>WWII - 1970</u> - Located in Midway. Contains eleven 60,000-barrel USTs for fuel. Tank bottom sludge was burned on-site. Approximately 100,000-175,000 gallons of oily sludge were disposed of on-site. A tank closure investigation was conducted for two USTs at the site. An IAS was conducted of the site. Site will be investigated under the current RI/FS.
14	Gould Island Disposal Area	<u>WWII</u> - All wastes generated on the island consisting of domestic trash, metal scrap, wood, pipes, rusted drums, two diesel oil tanks, and concrete. Wastes from electroplating and degreasing operations may also have been disposed of at the site. An IAS and CS were conducted of the site. Site will be investigated by the Army Corps of Engineers.
15	Gould Island Bunker #11	<u>WWII</u> - Site had drums containing possible hazardous waste from electroplating operations. An IAS was conducted on the site. NETC cleaned the site under a removal action.
16	Gould Island Incinerator	<u>WWII</u> - Six-ton capacity incinerator. No action required at site.
17	Gould Island Electroplating Shop	<u>WWII</u> - Wastes generated from electroplating and degreasing operations. Wastes included muratic acid, chromic acid, copper cyanide, sodium cyanide, sodium hydroxide, nickel sulfate, Anodex cleaner and degreasing solvents. Site has been excessed. An IAS and CS were conducted of the site. NETC cleaned the site under a removal action.
18	Structure #214 - Melville North	<u>1980 - 1982</u> - Area adjacent to Structure #214. Drums of waste oil and oily spillage. Site has been excessed. NETC cleaned the site under a removal action.

excessed is the Old Fire Fighting Training Area. The final sale of the remaining four excessed areas by the General Services Administration (GSA) is pending the results of the IR Program studies. The summary of the status of NETC hazardous waste sites is presented in Table 2.

This report is organized into two main sections, Site Background, and History of Response Actions. The first four subsections of the Site Background section address the regional physiography, geology, and hydrology of the NETC, as well as its general history. The last five subsections of the Site Background section deal with the specific history, geology, and hydrology of each site. The second section, History of Response Actions, presents a chronology of environmental regulatory actions which have impacted the NETC and the Navy's response to those actions. The second subsection of this section summarizes the results and conclusions of the IAS and CS concerning the environmental impacts of each site. Previous investigators' results are evaluated for reliability and completeness.

TABLE 2
STATUS SUMMARY OF NETC HAZARDOUS WASTE SITES

No.	Site	Present Owner	Action
1	McAllister Point Landfill	Navy	IAS/CS, RI/FS
2	Melville North Landfill	Private	IAS/CS, RI/FS
3	Transformer Vault Structure #214 - Melville North	Private	Navy Clean-Up
4	Coddington Cove Rubble Fill	Navy	IAS, No Action
5	Melville North Area	Private	IAS, Navy Clean-Up
6	STP Sludge Drying Bed	Private	IAS, Navy Clean-Up
7	Tank Farm #1	Navy	IAS/CS, RI/FS ⁽¹⁾
8	NUSC Disposal Area	Navy	IAS, No Action
9	Old Fire Fighting Training Area	Navy	IAS, RI/FS ⁽²⁾
10	Tank Farm #2	Navy	IAS, RI/FS ⁽¹⁾
11	Tank Farm #3	Navy	IAS, RI/FS ⁽¹⁾
12	Tank Farm #4	Navy ⁽⁴⁾	IAS/CS, RI/FS
13	Tank Farm #5	Navy ⁽⁴⁾	IAS, RI/FS
14	Gould Island Disposal Area	Navy ⁽⁵⁾	IAS/CS, RI/FS ⁽³⁾
15	Gould Island Bunker #11	Navy ⁽⁵⁾	IAS, Navy Clean-Up
16	Gould Island Incinerator	Navy ⁽⁵⁾	No Action
17	Gould Island Electroplating Shop	Navy ⁽⁵⁾	IAS/CS, Navy Clean-Up
18	Structure #214 - Melville North	Private	IAS, Navy Clean-Up

(1) Information obtained during the RI/FS of Tank Farm #4 and Tank Farm #5 will be used to develop remedial action for Tank Farm #s 1, 2, and 3.

(2) During a geotechnical investigation at the site, evidence of oil-contaminated soil was found. Therefore, the site will be studied under the RI/FS.

(3) Site #14 will be investigated by the Army Corps of Engineers (ACE).

(4) Sites are proposed to be excessed.

(5) The southernmost property on Gould Island which includes Sites 14-17 has been excessed by the Navy but this section of the island has not been accepted by the State of Rhode Island.

2.0 SITE BACKGROUND

This section presents a review of the history, geology, and hydrology of the NETC and the individual sites being addressed in this investigation. Extensive information in these areas has already been gathered in the IAS (Envirodyne Engineers, 1983) and CS (Loureiro Engineering Associates, 1985). Therefore, blocks of text will be incorporated from these reports and referenced with a "IAS" or "CS" and the appropriate reference page numbers.

2.1 History of the NETC

The NETC is located north of Newport, Rhode Island, (Figure 1) on the west shore of Aquidneck Island facing the east passage of Narragansett Bay (Figure 2). The history of the base is as follows:

The Newport area was first used by the Navy during the Civil War when the Naval Academy was moved from Annapolis, Maryland to Newport in order to protect it from Confederate troops. The Naval Academy operated at Newport for about four years before returning to Annapolis.

In 1869, the experimental Torpedo Station at Goat Island was established. This was the Navy's first permanent activity at Newport. The station was responsible for developing torpedoes and conducting experimental work on other forms of naval ordinance.

In 1881, Coasters Harbor Island was acquired by the Navy from the City of Newport and used for training purposes. In 1884, the Naval War College was established on the island. A causeway and bridge linking the island to the mainland was constructed in 1892. In 1884, the USS Constellation was permanently anchored as a training ship for the Naval War College.

The Melville area was established as a coaling station for the steam-powered ships in 1900. The Navy purchased 160 acres of land and constructed the Narragansett Bay Coal Depot. With the advent of ships burning liquid fuel, it became necessary to add oil tanks. Consequently, in 1910, four fuel oil tanks were added in the Melville area. These tanks are still used today.

In 1913, the Navy established the Naval Hospital on the mainland of Aquidneck Island, directly adjacent to Coasters Harbor Island. At this time, the main hospital building was constructed.

The outbreak of World War I caused a significant increase in military activity at Newport. Some 1,700 men were sent to Newport and housed in tents on Coddington Point and Coasters Harbor Island. A bridge was built at this time connecting Coddington Point with Coasters Harbor Island. In 1918, Coddington Point was purchased by the Navy. Much of the base organization was then transferred to Coddington

Point. During the war, numerous destroyers and cruisers were fueled by the Melville coal depot and fuel tanks. By this time, a pipeline had been extended to the north fueling pier and two additional oil tanks constructed.

Following World War I, fuel oil gradually replaced the use of coal by the Navy fleet. In 1921, the Coal Depot was changed to the Navy Fuel Depot. In 1931, the coal barges and coaling equipment were sold to the highest bidder.

In 1923, some two hundred buildings, which were part of the emergency war camps established on Coddington Point, were stripped and sold for scrap. The station was put on caretaker status in 1933. The base remained relatively inactive until the onset of World War II.

Reactivation of the base occurred in the late 1930s as a result of military build-up in Europe. Just prior to the reactivation, a 1938 hurricane and tidal wave had destroyed or severely damaged over 100 buildings and much of the sea walls. In 1940, Coddington Cove was acquired for use as a supply station, and hundreds of Quonset huts were constructed throughout the base. Additional barracks were constructed on Coasters Harbor Island, increasing the base housing capacity to over 3,500 men. Power plant facilities were also constructed at this time. Coddington Point was reactivated to house thousands of recruits. The Anchorage housing complex in the Coddington Cove area was constructed in 1942. In the Melville area, additional fuel facilities were constructed along with a Motor Torpedo Squadron Boat Training Center and nets for harbor defense were constructed. Tank Farms 1 through 5 were constructed during this time period. The Fire Fighting School, Fire Control Training Building, and the Steam Engineering Building were constructed in 1944.

The Torpedo Station at Goat Island was very active during World War II and had expanded its operation to Gould Island. The Torpedo Station employed more than 13,000 people and manufactured 80 percent of all torpedoes used by our country during the war. The station was the largest single industry ever operated in Rhode Island.

Following World War II, naval activities at Newport converted to a peace time status. This resulted in a reduction of naval activity. Some 300 Quonset huts and buildings were removed, and the entire naval complex was consolidated into a single naval command designated the U.S. Naval Base in 1946.

The Naval Base adjusted to its peace time status by increasing its activities in the fields of research and development, specialized training, and preparedness for modern warfare. There was a brief period during the Korean War when some 25,000 sailors trained at Newport.

In 1951, the Torpedo Station was permanently disestablished after 83 years of service. Future manufacture of torpedoes was to be awarded to private industry. In place of the Torpedo Station, a new research and development facility, the Naval Underwater Ordnance Station, was

established and given the responsibility of overseeing the private contractors. The Officer Candidate School was also established in 1951.

In 1952, the Training Station and other naval schools were disestablished, and the U.S. Naval Station and the U.S. Naval Schools Command were established.

In 1955, Pier 1 was constructed, with Pier 2 being added in 1957. Newport became the headquarters of the Commander Cruiser-Destroyer Force Atlantic in 1962. Some 55 naval warships and auxiliary craft were homeported at Newport. New housing and bachelor quarters were added in the late 50's and early 60's.

Major expansion of the Naval War College occurred during the late 50's and early 70's, transforming the college into a major university. In July of 1971, the Naval Schools Command was restructured and named the Naval Officer Training Center (NOTC).

In April of 1973, the Shore Establishment Realignment Program (SER) was announced and resulted in the largest reorganization of Naval forces in the Newport area. The fleet stationed in Newport was relocated to other naval stations on the east coast. SER resulted in the disestablishment of the Naval Communication Station and the Fleet Training Center and related activities. The Public Works Center, Naval Supply Center, Naval Station and Naval Base were absorbed by NOTC. In April of 1974, NOTC was changed to the Naval Education and Training Center (NETC).

The drastic changes which resulted from SER caused a reduction of Navy personnel, both military and civilian, in excess of 14,000. Coupled with the reductions at the Naval Construction Battalion Center at Davisville, and the closure of the Naval Air Station at Quonset Point, SER had severe economic impacts in the Narragansett Bay area.

The reorganization brought about by SER resulted in the Navy excessing some 1,629 acres of its 2,420 acres. Some of the land has been leased to the State of Rhode Island pending final sale of the land by the General Services Administration. Table 3 shows an area by area breakdown on land holdings prior to SER and following. The Navy also leases 44 acres of land in Coddington Cove to the State of Rhode Island and Economic Development Corporation. The state has subleased this property to a private enterprise engaging in shipbuilding and repair. Also, a fish food processing operation utilizes the cold storage warehouse in Building 42 near Pier 1.

The above information on the history of the installation was obtained from the most recent Master Plan (NORTHDIV, 1980), the 1981 Annual Report of the Navy in the Rhode Island Area (NETC Public Affairs Office, 1981), and the Command Histories at the Naval History Office in Washington, DC.

(IAS, pp. 5-6 to 5-14)

TABLE 3

LAND HOLDINGS - NEWPORT NAVAL COMPLEX

(Adapted from IAS Report (Envirodyne, 1983))

Area	Acreage		
	Pre-SER	Excessed	Retained
Coasters Harbor Island	112	0	112
Medical Center	42	0	42
Cloyne Court Housing	26	0	26
Coddington Point	160	0	160
Coddington Cove	226	74	152
NUSC	198	0	198
Melville South) Midway) Defense Highway)	441	319	122
Melville North	462	246	216
Prudence Island	600	600	0
Gould Island	52	43	9
Fort Adams	102	77	25
Sachuest Point	107	105	2
Fort Wetherill	7	7	0
Beavertail Point	<u>158</u>	<u>158</u>	<u>0</u>
	<u>2,693</u>	<u>1,629</u>	<u>1,064</u>

2.2 Regional Physiography

This section is divided into three subsections: climate, terrestrial features, and marine features. Regional geology and hydrology will be addressed in separate sections following this discussion.

2.2.1 Climate

The climate at NETC is greatly influenced by its proximity to Narragansett Bay and Atlantic Ocean, which tend to modify the area's temperatures. Winter temperatures are somewhat higher and summer temperatures lower than more inland areas. Winters are moderately cold in the area, and summers are generally mild with many summer days cooled by sea breezes. . . .

The average annual precipitation for the area is 42.75 inches, but this has varied from as little as 25.44 inches to as much as 65.06 inches. Measurable precipitation (.01 inch or greater) occurs on about one day out of every three and is evenly distributed throughout the year. Thunderstorms are responsible for much of the rainfall from May through August. These thunderstorms often produce heavy amounts of rainfall, but their duration is relatively short. Summer thunderstorms are frequently accompanied by high winds which may result in property damage, especially to small boats. The average snowfall during winter is close to 40 inches, ranging from a low of 11.3 inches to a high of 75.6 inches. February is usually the month of greatest snowfall, but January and March are close seconds. It is unusual for the ground to remain snow covered for any long period of time. . . .

Severe weather from tropical cyclones (winds 39 to 73 miles per hour) and hurricanes (winds greater than 73 miles per hour) is a serious threat in the area of NETC. The probability that a tropical cyclone will invade the area is one in five in any year, while the probability of hurricane force winds invading the area is less than one in fifteen in any year (Outleasing EIS, 1977). The most damage from these severe storms results when they strike at high tide.

(IAS, pp. 5-14 to 5-15)

2.2.2 Terrestrial Features

The topography of the NETC area was shaped by the bedrock geology, glaciation, and recent erosion. The bedrock geology controlled the locations of the ancient river valleys which glaciers subsequently gouged out of the bedrock. The hills are the result of bedrock highs. A mantle of till, on average 20 feet thick, was spread over the bedrock during the Wisconsin glaciation. As the glaciers melted, ocean levels rose and flooded the river valleys forming the passages of Narragansett Bay.

Elevations at NETC range from near mean sea level to 175 feet in the Melville North area. Many areas of NETC have low elevations which are susceptible to flooding during hurricane storm surges. The 100 and 500 year tidal flood elevations for the NETC area are 12.6 feet and 15.6 feet above mean low water, respectively. Areas below these elevations are subject to flooding.

Ninety percent of the land within the boundaries of NETC has slopes of from 0 to 9 percent (Master Plan, 1980). The remaining land has slopes in the categories of 10 to 25 percent and greater than 25 percent. Maps showing slopes on all NETC areas are included in the most recent Master Plan for NETC.

(IAS, pg. 5-15)

The soils in the area of NETC formed in glacial deposits of till and outwash. . . . There are also a few areas with tidal marsh soils along the shores of Narragansett Bay. These tidal marsh areas receive deposits of silt and clay during tidal inundation and from upland areas. These sediments are deposited along with the plant remains of the salt tolerant plants growing in the marshes.

(IAS, pg. 5-21)

There are five basic types of soils at the NETC: mucks, beaches, loams, sands, and urban complexes. The mucks are found in tidal flats and inland depressions which hold ponded water. Loams (mixture of sand, silt, clay, and organic matter) and sands are found in upland areas on-site and generally drain rapidly. Urban complexes are mixtures of natural soils, imported soils, and urban materials.

The flora and fauna of the NETC is strongly influenced by human activity.

The southern portion of the base is heavily industrial with machine shops and other support facility operations. The north portion of the base is divided in land usage between residential, vacant (held for expansion), tank farms, and storage-fueling facilities (industrial). There are no land areas on NETC which have not been disturbed at some time during base operations. . . .

Southern Rhode Island has relatively few forests of mature climax successional stage. Fires, logging, and the agricultural conversion of forest land prior to the Civil War have greatly reduced the extent of climax forest acreage. The predominant forest vegetation in southern Rhode Island is that of abandoned fields in early successional stages, and forests of immature hardwoods. Pure stands of mature softwoods are the least abundant. . . .

The upland vegetation within the NETC is restricted primarily to perennial weeds and grasses. The majority of trees is located near

residences, drainageways and around the tank farms. The upland vegetation of NETC reflects complete management (mowing) or recent disturbance of the area.

The habitats available for lowland vegetation on the NETC are located on the waterfront along Narragansett Bay and surrounding the small impoundments and their drainages further inland. Those areas located on the waterfront are comprised of borrow pits along the railroad tracks and abandoned disposal areas where excavation has created depressions.

The largest of these depressions is the Melville North landfill. This area was excavated during landfill operations and depressions were created. These depressions support a limited diversity of wetland flora including reeds and various shrub and grass species. Borrow pits can be found along the railroad tracks which parallel the shoreline extending from McAllister Point northward to the Melville North landfill. These are individually less than one acre in size and contain similar wetland species with a lack of diversity.

All lowlands on NETC have been artificially created and are in a disturbed condition. The potential for maintaining diversified floral species within the lowlands of NETC is poor. This area did not previously contain these habitats, and sills and drainage are not conducive to their successional development.

The fauna of the region have been affected by similar disturbances (clearing, excavation, construction) which led to the impoverishment of the flora. Field studies have indicated impoverished fauna, particularly of herptile and mammal types. Widespread habitat destruction over a period of several hundred years has caused emigration or elimination of many species. As a result, the present regional fauna consist primarily of species of wide distribution and ecological tolerances, high adaptability, and nonrestrictive habitat requirements.

No large animals such as deer, turkey, or cougar are known within the boundaries of NETC. However, red fox, raccoon, rabbit, and gray squirrel are present in the woodlands.

Mammalian forms expected to be found on base include: the Eastern chipmunk, New England cottontail rabbit, white-footed mouse, short tailed shrew, gray squirrel, and red squirrel. Several of these species inhabit the few remaining wooded areas on base slated to be excessed.

Various herptiles occupy NETC habitats. Common ones include the red backed salamander, American toad, wood frog, eastern gartersnake, northern black racer and the wood turtle.

Common herptiles of the wet areas include the American toad, spring peeper, bullfrog and northern watersnake (Natrix sipedon), along with the snapping turtle.

Avian species which may be found within the NETC upland habitats include the bobolink, meadowlark, chimney swift, kingbird, eastern phoebe (Sayorius phoebe), barn swallow, red-tailed hawk and kestrel.

In addition, game birds, such as the ring-necked pheasant, bobwhite quail and the mourning dove, are highly dependent on the plant communities on the base.

(IAS, pp. 5-37 to 5-39)

2.2.3 Marine Features

Narragansett Bay occupies three former river valleys which have been drowned by the advance of the Atlantic Ocean. Narragansett Bay is 20 miles long and 11 miles wide. The bay has a surface area of 102 square miles. Figure 3 shows Narragansett Bay and the surrounding areas. The shape of the former river valleys has changed little since the last glaciation. The bay is divided into an eastern and western passage by Conanicut Island. The average depth of the bay is 30 feet. In the western passage, the average depth is 25 feet, while in the eastern passage, the average depth is 50 feet. The eastern passage, which NETC fronts, allows deep water access up to the south end of Prudence Island. Channel depth exceeds 80 feet in the eastern passage from Gould Island seaward, and depths in excess of 150 feet occur near the mouth of the bay.

Freshwater flows into the bay at an average rate of 1,239 cubic feet per second from a drainage area of 1,850 square miles. This accounts for 90 percent of the annual flow of fresh water into the bay. The other 10 percent is provided by direct rainfall into the bay and sewage effluent. An average of some 43 inches per year of precipitation falls directly into the bay. The freshwater input into the bay is small compared to the large volume of saline water in the bay. The relatively small freshwater input into the bay results in the bay water being well mixed with only small salinity gradients through the bay. Salinities range from about 22 parts per thousand (ppt) in the Providence River to 32 ppt at the mouth of the bay.

Tides are semi-diurnal in Narragansett Bay with a mean range of 3.6 feet at the mouth of the bay and 4.6 feet at the head. About 13 percent of the volume of water in the bay is exchanged each tidal cycle (Oviatt and Nixion, 1973). This is over 250 times the mean tidal river flow into the bay during a tidal cycle. The tidal movement is the single most important factor in water circulation in the bay. Tidal currents range in velocity from 0.07 to 2.3 feet per second (Atlantic Scientific, 1982). The faster velocities occur in the east and west passages near the mouth of the bay, while slower velocities occur in the upper bay.

Non-tidal current in the bay moves slowly at an average of 0.34 feet per second (Olsen, 1980). Although the non-tidal currents are slow, they are important in the exchange of water out of the bay and into Rhode Island Sound. The amount of time needed to transport a

particle of water from Providence to the mouth of the bay is some 45 to 50 days (Olsen, 1980). However, this time can vary depending on the winds. Research seems to indicate that southeast winds blowing up the bay may prevent surface waters from flowing down the bay (Olsen, 1980).

The sediments in the bay are contaminated with heavy metals, hydrocarbons, and sewage sludge (Master Plan, 1980). A survey conducted by EPA (EPA, 1975) has shown the presence of heavy metal concentrations in the sediments in interstitial waters north of the Naval Complex. The values found were 7,048 mg/l manganese, 2,351 mg/l zinc, 559 mg/l iron, 55 mg/l lead, 46 mg/l nickel, 44 mg/l copper, and less than 1 mg/l cadmium. These contaminants are the result of industrial and municipal discharges into the bay. No sediment samples have been taken in the area of the Naval Complex.

The water quality for Narragansett Bay as determined by the State of Rhode Island is shown in Figure 4. Most of the bay is Class SA, which means it is suitable for direct shellfish harvesting, bathing and other water contact sports. Areas classified as SB are suitable for shellfish harvesting after depuration and for bathing and other recreational activities. Areas classified as SC are suitable for fish, shellfish, and wildlife habitat areas, but the shellfish cannot be harvested. The entire shoreline of NETC is closed to shellfishing.

(IAS, pg 5-28, 5-31)

The marine ecosystem of Narragansett Bay forms the shoreline of the base for approximately 9 miles. The bay is of great economic and aesthetic importance of the entire southern portion of Rhode Island. It is an estuary and the fishery resources of the bay are extremely important. The annual value of the combined commercial and sport fishing is estimated at several million dollars.

In Narragansett Bay, the phytoplankton are by far the most important primary producers, synthesizing organic matter from carbon dioxide and inorganic nutrients with sunlight as the energy source. In shallower, less turbid estuaries, seaweeds and sea grasses may assume this role. . . .

The phytoplankton and zooplankton are rich and varied in Narragansett Bay. The species composition is relatively uniform from station to station indicating a good movement of the water mass within the bay. The estimated productivity figure of 84 grams of carbon per square meter per year is also indicative of good environmental conditions. . . .

Most species of finfish move in and out of Narragansett Bay following well established seasonal patterns. These migratory movements, although different for each species, provide for distinct summer and winter populations of finfish. The migrations are related primarily to temperature, and the major shifts between winter and summer populations take place when the water temperature is about 10°C (50°F).

Narragansett Bay is visited each year by a great many species of fish because it lies along the boundary between southern and northern populations. Thus, herring from Georges Bank may visit the bay at the end of their southward midwinter migrations, and species such as scup and occasional exotic tropical strays brought up by the Gulf Stream make their appearance during the summer. In all, over 100 species may appear in any given year, about half of which are occasional visitors.

In various studies during the 1970's a total of 99 species of fish have been taken from Narragansett Bay (Oviatt and Nixon, 1973; Jeffries and Johnsons, 1974; Camp, Dresser and McKee, 1978; Department of the Navy, 1978). Ten species accounted for 91 percent of the fish catch with the winter flounder, the sand dab, scup and butterfish the most commonly occurring fish taken. These four species are also of commercial importance. . . .

A year-long, bay-wide survey (excluding Mount Hope Bay and the Sakonnet River) of bottom fish made in 1972 yielded an annual minimum estimate of 117 individuals, or 28.5 pounds per acre. This translates into a standing crop of 1.9 million pounds of bottom fish. (The margin of error gives a range of 0.8 to 2.9 million pounds.) This is comparable to other estimates made using similar sampling techniques in New England estuaries and offshore fishing grounds. This bay-wide survey showed that despite the constant movement of species in and out of the bay, the total biomass of bottom fish is remarkably steady.

There are fewer species of pelagic fish than of bottom fish in the bay, but they make up for this by their numbers and their importance to fishermen. All the pelagic species are highly seasonal, with anchovies and sea herring appearing in the winter, and menhaden, bluefish, and striped bass in the summer. When schools of menhaden are present, their biomass may be far greater than that of the bottom fish. Population estimates for the bay are for as much as 16 million pounds of menhaden and 2 million pounds of bluefish and stripers. . . .

The benthic community in Narragansett Bay plays a critical role in the functioning of the ecosystem. Benthic filter feeders consume significant amounts of phytoplankton, and the bay's high primary productivity may be attributable in good part to the recycling activity of the benthos. . . .

The shellfish of Narragansett Bay include both bivalve molluscs (clams, oysters, scallops) and decapod crustaceans (crabs, shrimp, lobster). Lobster are caught both within and outside of Narragansett Bay. Lobsters are trapped in much of Narragansett Bay including the Coddington Cove area. Some lobster traps are located a short distance from Pier 2.

Bivalves harvested in the region of Narragansett Bay include the northern quahog - known as the bay quahog in Rhode Island), soft shell clam, and Atlantic bay scallop.

The quahog is the most valuable shellfish resource within the bay system. The number of people harvesting this organism for individual or commercial use is increasing. Shellfishing areas open to the public do not include the NETC shoreline.

Quahogs are the most abundant benthic animal of their size in Narragansett Bay (URI, 1980, Bulletin #40). In recent years, the total Rhode Island harvest ranged from 5 million pounds of meats in 1955 to 2 million pounds in 1978, the great majority of which are taken from the bay. . . .

Water pollution continues to take a heavy toll in the reduced numbers of quahogs available for harvesting. The primary criterion used in closing areas to shellfishing is the abundance of fecal coliforms in the water; these are an indicator of sewage and the pathogenic bacteria and viruses it may contain. A shellfish depuration plant is capable of killing harmful microorganisms that might be found within the shellfish, but none has been built in the bay area. Unfortunately, pathogenic microorganisms are only one aspect of the pollution in the upper bay. There are signs that Providence River quahogs are not healthy and may be dying off at least in some areas. Several researchers are concerned that they may be accumulating significant levels of petroleum or heavy metals, which are not removed by the usual depuration methods.

Aquaculture within the bay includes the eastern oyster and the blue mussel. Two species of clams are harvested offshore and landed at bay fishing ports. They are the Atlantic surf clam and the ocean quahog. Most of the northern areas of the bay are closed permanently or opened on a conditional basis. Most of the lower bay localities are opened. The shellfish area just south of the Newport Naval Facility is permanently closed because of municipal sewage discharge.

A small commercial fishery for squid occurs in the bay. A large squid trap is presently located in Coddington Cove (RI DEM, 1982). Sportsmen harvest squid with rod and reel throughout the spring and early summer months in the lower bay.

The blue crab and the rock crab are taken throughout the bay by recreational fishermen. Both of these species inhabit the shallow bays, sounds, and pools during the warm months and migrate to deeper water in the fall. The commercial fishing for blue crabs ended in 1938 with a severe population decline. The reason for the decline is not understood, but pollution from heavy metals and chlorinated hydrocarbons may have played an important role. [Note: The actual cause of the blue crab population decline is not documented.] At present, the population of blue crabs is increasing. The commercial use for rock crabs will be expanded with the development of new techniques for extracting the crab meat from the shells.

The Blue Gold Sea Farm, Inc. has leased five acres north of NETC for rearing the blue mussel. They suspend string from floats to which the larval stages of the mussel attach. It takes about 18 months for these mussels to reach market size. Eastern oysters are being

cultured on suspended strings in coastal ponds on Prudence Island and southwestern shores of the bay. Scallop seed is planted in the bay, and in 1978, the catch was valued at one million dollars (Rhode Island Statewide Planning Program, 1979).

(IAS, pp. 5-40 to 5-47)

2.3 Regional Geology

NETC is located at the southeastern end of the Narragansett Basin. This basin is a complex synclinal mass of Pennsylvanian aged sedimentary rocks and is the most prominent geologic feature in eastern Rhode Island and adjacent Massachusetts. Narragansett Basin is an ancient north to south trending structural basin originating near Hanover, Massachusetts. The basin has a length of approximately 55 miles and varies from 15 to 25 miles wide. The western margin of the basin is in the western portion of Providence, Rhode Island, and the eastern margin runs through Fall River, Massachusetts. Exposures of older rocks on Conanicut Island and in the vicinity of Newport suggest that the southern extent of the basin is near the mouth of Narragansett Bay.

The rocks of the Narragansett Basin are non-marine sedimentary rocks of Pennsylvanian age. The rocks are chiefly conglomerates, sandstones, shales, and anthracite. Total thickness of the strata in the Narragansett Basin has been estimated at 12,000 feet. Both vertical and lateral irregularities in the lithologic character of the rock are present within the basin. Many folds and some faults occur throughout the basin, but the character and amount of the folding and faulting are not clearly known. The sedimentary rocks of the basin are believed to have been deposited in a lowland area which was surrounded by an upland area of considerable relief. The presence of coal beds within the basin also indicates that there were fairly extensive swampy areas. Figure 5 shows a general geologic map of Rhode Island.

The bedrock of the Narragansett Basin has been divided into the following five units: the Rhode Island Formation, Dighton Conglomerate, Wansulta Formation, Pondville Conglomerate, and Felsite at Diamond Hill. AT NETC and most of the surrounding area, the bedrock is entirely of the Rhode Island Formation, and thus, only this unit will be examined in detail. Figure 6 represents a detailed look at the geology at NETC and the surrounding areas.

The Rhode Island Formation is the most extensive and thickest of the Pennsylvania formations in Rhode Island. The vast majority of the Narragansett Basin is underlain by this formation. Included within the Rhode Island Formation are fine to coarse conglomerate, sandstone, lithic graywacke, graywacke, arkose, shale and a small amount of meta-anthracite and anthracite. Most of the rock is gray, dark gray, and greenish, but the shale and anthracite are often black. Crossbedding and irregular, discontinuous bedding is characteristic of the formation. Rocks of the Rhode Island

Formation, which are in the northern portions of the basin, are strong and indurated but are not metamorphosed. However, those rocks in the southern portion of the basin, such as the NETC, are metamorphosed, and these rocks contain quartz-mica schist, feldspathic quartzite, garnet-stacrolite schist, and some quartz-mica-sillimanite schist. The beds of meta-anthracite and anthracite are mostly thin, but many areas within basin have been mined. Vein quartz, fibrous quartz, and pyrite are commonly associated with these coal layers, and the ash content is high.

Within the Rhode Island Formation, there are a few areas of thick conglomerates. These conglomerate layers are gray to greenish in color and are mostly very coarse. These conglomerates consist of pebbles, cobbles, and boulders (up to several feet long), interbedded with sandstone and graywacke. The stones are predominantly quartzite and have been elongated as a result of tectonic forces in the southern portion of the basin. These thick conglomerate layers are more resistant to erosion than are the surrounding rocks and thus, are topographically higher. Coasters Harbor Island is mostly covered with this conglomerate material.

Throughout the Narragansett Basin, the Pennsylvanian rocks are underlain by pre-Pennsylvanian igneous and metamorphic rocks such as Bulgarmarch granite, Metacom granite gneiss, porphyritic granite and slate and quartzite. For the most part, these basement rocks are deeply buried beneath the Pennsylvanian rocks. However, these older rocks occur north of NETC in the Bristol area and south of NETC in the Fort Adams and Newport Neck areas and on the southern tip of Conanicut Island. Rose Island and Goat Island also have older metamorphic rocks of slate and quartzite.

Overlying the Pennsylvanian rocks of the Narragansett Basin are surficial deposits of Pleistocene sediments. These Pleistocene sediments owe their origin to the Wisconsin glaciation which covered the area with ice several thousand feet thick. As the glaciers receded some 10,000 to 12,000 years ago, they deposited unconsolidated glacial materials of variable thicknesses throughout the Narragansett Basin area. The unconsolidated glacial material ranges from 1 to 150 feet thick, being thicker in the valleys and thinner in the uplands. The glacial material consists of till, sand, gravel, and silt. These glacial deposits were derived from shale, sandstone, conglomerate, and in a few places, coal. The glacial materials serve as the parent materials for the soils in the area. Areas where sand and gravel were deposited serve as important regional mineral sources. . . .

(IAS, pp. 5-18, 5-21)

Over most of the bay floors, thick glacial deposits are buried beneath up to 50 feet of sediments. These sediments are predominantly sand, gravel, silt, and clay. The sediments near the mouth of the bay are more sandy than those in the upper bay which have more silt and clays. This is a reflection of the current velocities in the bay. . . .

(IAS, pg. 5-31)

Much of the geologic information contained in this section was obtained from Geological Survey Bulletin 1295 (Quinn, 1971). . . .

(IAS, pg. 5-21)

2.4 Regional Hydrology

The regional hydrology for the NETC will be discussed in two following subsections covering surface water and ground water.

2.4.1 Surface Water Hydrology

NETC is located within the Narragansett Bay Drainage Basin. This drainage basin covers an area of 1,850 square miles, 1,030 square miles of which are in Massachusetts and 820 square miles of which are in Rhode Island. All surface water drainage from the basin is into Narragansett Bay. Three major rivers, the Taunton, Blackstone, and Pawtucket, as well as the Providence River and a number of smaller rivers and streams, drain into Narragansett Bay. Discharge from Narragansett Bay is into the Atlantic Ocean between Point Judith and Sakonnet Point in Rhode Island.

Throughout NETC, the surface drainage is westward toward Narragansett Bay with the exception of one area in Tank Farm #2 which drains eastward into Melville Reservoir. Surface drainage at NETC is provided by the Melville Ponds, Normans Brook, Lawton Brook and Reservoir, Gomes Brook, a stream and pond in the northeastern portion of NUSC, and a stream discharging into Coasters Harbor. The surface drainage for NETC is shown in Figure 7. All these streams discharge into Narragansett Bay. . . .

Except for the stream and pond at NUSC and the stream which empties into Coasters Harbor, all of the other streams and ponds are on land which is being exceded by the Navy. The Melville Ponds have been disposed of by GSA and are now part of the Melville Public Fishing Area.

While these streams and ponds receive drainage from many of the areas within NETC, a substantial portion of the NETC area drains directly into Narragansett Bay or infiltrates into the soil before reaching a stream or body of water. Direct runoff into Narragansett Bay would especially occur following thunderstorms. . . .

(IAS, pp. 5-26, 5-28)

The potential for pollutant migration by surface drainage at NETC is greatly increased by its proximity to Narragansett Bay. Many of the waste disposal areas, such as the McAllister Point landfill, Melville North disposal site and Gould Island disposal site, are located right along the shoreline of Narragansett Bay. Surface drainage from these areas is directly into the bay. The NETC area is frequently subjected to thunderstorms during which intense periods of rainfall

are common. Surface drainage into the bay would be greatest following these thunderstorms.

Pollutants from these portions of NETC drain into the Melville Ponds, Normans Brook, Lawton, Brook, Gomes Brook, and the NUSC stream and would also migrate off-site. All of the streams discharge directly into Narragansett Bay.

(IAS, pg. 5-34)

2.4.2 Ground Water Hydrology

Many areas on Aquidneck Island, on which NETC is located, obtain their water supply from wells. Areas relying on ground water are mostly north of the Middletown area, but there are wells throughout the entire island. Most ground water is used for domestic needs, although some is used by small industries and businesses.

Ground water on Aquidneck Island is obtained from the unconsolidated glacial deposits of till and outwash and from the underlying Pennsylvanian bedrock. Throughout the area, depth to ground water ranges from less than one foot to about 30 feet, depending upon the topographic location, time of year, and character of subsurface deposits. The average depth to the ground water is around 14 feet on Aquidneck Island and moves from areas of high elevations to Narragansett Bay or the Sakonnet River.

Seasonal water level fluctuations are common in the area. These fluctuations range from less than 5 feet to as much as 20 feet on the hills. In the valleys and lowland areas, the fluctuations are generally less than 5 feet. During the late spring and summer, the water table usually declines as a result of evaporation and the uptake of water by plants, and rises during autumn and following winter thaws.

The unconsolidated glacial deposits range in thickness from less than one foot near the rock exposures to about 50 feet throughout Aquidneck Island. Most of the glacial deposits are till, but isolated outwash areas occur. In the NETC area, the glacial deposits are till with a thickness of less than 20 feet. Wells completed in the till are usually dug and range in depth from less than 10 feet to as much as 75 feet. The average depth for these wells is about 20 feet. These dug wells are usually 2 to 3 feet in diameter and are usually dug down to the top of the bedrock.

The yield of till wells varies considerably depending upon the type and thickness of the water-bearing deposits penetrated. Yields range from less than one to as much as 120 gallons per minute. Under normal weather conditions, till wells yield a few hundred gallons of water per day and are adequate for domestic supplies. The large diameter of dug wells also provides substantial water storage area between periods of use. Each foot of water in a 3-foot diameter well represents storage of 53 gallons. However, these wells are subject to going dry during seasonal or unusual droughts.

Bedrock wells in the area range from 14 to 1,300 feet in depth. The average depth for these bedrock wells is 135 feet. Yields from bedrock wells range from less than one to as much as 55 gallons per minute. Most wells yield less than 10 gallons per minute. The yields vary considerably in the bedrock over short distances because the joints and fractures which transmit water to the wells occur intermittently. Joints and fractures are most numerous and widest near the top of the bedrock and become fewer and narrower with depth. Bedrock wells seldom go dry, but yields can be extremely low if not enough fractures and joints occur in the area of the well.

The chemical characteristics of the ground water are similar throughout the area, and the water is generally satisfactory for most ordinary uses. Most ground water in the area is soft or only moderately hard, with ground water from till generally containing less mineral matter and being softer than ground water from bedrock. Areas where the ground water has high iron content are scattered throughout the area, being most numerous around Newport and Middletown and the northern part of Portsmouth. Wells which have a high iron content usually penetrate only rocks of Pennsylvanian age.

In scattered locations near the shoreline, over-pumping has led to salt water intrusion in some wells. Bedrock wells are not as easily contaminated with salt water as are till wells, but the chance of contamination increases as the depth of the well below sea level increases.

No wells were identified within the boundaries of NETC other than on Gould Island, although there are numerous wells in close proximity. These wells are upgradient of NETC. . . .

(IAS, pp. 5-31 to 5-34)

The ground water at NETC is very shallow, being less than 10 feet below the surface in most areas. This shallow depth makes ground water contamination at NETC very possible. Those pollutants which do find their way into the ground water would migrate to the west and discharge into Narragansett Bay. NETC extends along the western shoreline of Aquidneck Island, and the ground water only has to migrate a short distance before discharging into Narragansett Bay.

The soils occurring at NETC have permeabilities which are moderate to moderately rapid, and they do not restrict the vertical movement of water. The glacial till, from which these soils were derived, is generally less permeable than the overlying soils but does not represent a barrier to the vertical migration of water. Therefore, it is possible that any contaminant transported in this water could contaminate the ground water. There are also isolated areas where the bedrock occurs at the surface. Contamination is possible in these areas through the cracks and fissures which commonly occur in the bedrock.

(IAS, pg. 5-34)

[The following five subsections of this report present the history, geology, and hydrology for each of the five sites being studied in the RI/FS.]

2.5 Site 01 - McAllister Point Landfill

McAllister Point Landfill has been investigated in both the IAS and CS. The following subsections will present the history for this site as developed in the IAS and the geology and hydrology based on the CS field investigations. A map of the site is presented as Figure 8.

2.5.1 History

This is the site of a sanitary landfill which was operational over a 20-year period. The site was first used in 1955 following the closure of the landfill in Melville North. The site continued to be used as a landfill until the mid-1970's and encompasses approximately 6 acres. The site is located on land which is being excessed by the Navy.

During the years that the site was operational, it received all the wastes which were generated at the naval complex. This included wastes from all the operational areas (machine shops, ship repair, NUSC, etc.), Navy housing areas (domestic refuse), and from the 55 ships which were homeported at Newport prior to the 1973 SER action. Generally, 25 to 30 of these ships were in port at any one time. Each day, fourteen 40-cubic yard containers were emptied from the pier areas and disposed of in the landfill. The materials disposed of at this site included spent acids, paints, solvents, waste oils (diesel, lube and fuel), and PCB-contaminated transformer oil.

The operators of the landfill indicated that it was common practice for barrels filled with liquids to be brought to the landfill. These barrels contained paints, oils and other unidentifiable liquids. The barrels were crushed by the bulldozer operator before being covered. It was also discovered through interviews with base personnel that at least two transformers, each of which contained approximately 100 gallons of PCB-contaminated oil, and at least 4 or 5 capacitors were disposed of in the landfill. The Superfund notification for McAllister Point indicated that PCBs were disposed of at the site.

For the period 1955 through 1964, wastes were simply trucked to the site, spread out with a bulldozer, and then covered over. In 1965, an incinerator was built at the landfill. From 1965 through 1970-71, some 98 percent of all the wastes were burned before being disposed of in the landfill. The incinerator was closed about 1970 as a result of the air pollution it was causing. During the remaining years that the site was operational, all wastes were again disposed of directly into the landfill.

The site is located along the shoreline of Narragansett Bay as shown in Figure 8. Throughout the time period that the site was operational, the landfill was extended out into the bay using the wastes as fill material. The site used to be subject to periodic flooding until the elevation of the site was increased through additional filling. . . .

Operations at the site were discontinued in the mid-1970's. Following this, all wastes generated at NETC were disposed of at the City of Newport's transfer station. A final covering of soil three feet thick was placed over the NETC landfill following its closure.

(IAS, pp. 6-25, 6-31)

2.5.2 Geology

The geology beneath the McAllister Point Landfill was determined from the boring logs of two monitoring wells installed on the site and one installed near the site by Clarence Welti Associates, Inc. under contract to Loureiro Engineering Associates. The well locations are shown in Figure 9. The boring for monitoring well number 21 encountered 38 feet of refuse on top of till. The till was penetrated to a final depth of 43 feet. The other downgradient boring, number 22, encountered only 15 feet of refuse on top of till. Monitoring well 21 was constructed with the screened interval entirely in refuse (38 to 28 feet) while monitoring well 22 was screened in the till beneath the refuse (25 to 15 feet). The upgradient monitoring well, number 23, is located topographically 35 feet higher than the downgradient wells. The boring penetrated 2 feet of soil, 5 feet of till, and 33 feet of weathered shale. The competency of the weathered shale increased with depth. The well screen was installed at 40 to 30 feet placing it 10 feet above mean sea level. The screens for the two downgradient wells, numbers 21 and 22, are 4 to 18 feet below sea level, respectively.

McAllister Point protrudes into the bay, which may indicate that till or bedrock exists over much of the site. The well boring logs indicate that no soil layers were found to be separating the refuse layer from the till layer.

2.5.3 Hydrology

Water levels measured in the three monitoring wells installed at the site indicate that ground water is flowing from east to west towards the bay. The effects of tidal fluctuations on the monitoring wells' water levels were not well documented in the CS.

Hydraulic conductivity tests were not conducted on the monitoring wells; however, during well development with air surging, the time for recovery of

the original well water levels was recorded. A significant contrast in recovery times was observed between the well (21) screened in refuse (20 minutes) versus the two wells (22, 23) screened in till (50 minutes) and bedrock (60 minutes). This indicates that sea water and ground water move through the refuse 2 or 3 times more easily than in the till and bedrock, respectively.

Some inconsistencies are present in the Loureiro report between the drillers' logs, the site map, and the well construction summary tables. The description given above was based on the drillers' logs and site map; the summary tables were assumed to be incorrect.

2.6 Site 02 - Melville North Landfill

This section presents the site-specific history, geology, and hydrology for the Melville North Landfill. This site was investigated in both the IAS and CS. A map of the site is presented as Figure 10.

2.6.1 History

This site was used as a landfill for at least the period following world War II until 1955. The date that the site first began to be used as a landfill is unclear, but all indications are that it was after the war. Following its closure in 1954, wastes generated at the naval complex were disposed of at the McAllister Point Landfill. The site encompasses approximately 10 acres.

The Melville North Landfill would have received wastes similar to those which were disposed of in McAllister Point Landfill, including spent acids, waste paints, solvents, waste oils (diesel, fuel, lube) and, potentially, PCBs. The quantity of these wastes disposed of in the landfill is unknown. During visual inspections of the site, areas covered with oil and oil sludge were found to be scattered throughout the site. There were mounds of oil-soaked soil which appeared to have been trucked to the site and dumped. These oil-contaminated mounds could be the oil sludge material obtained from the tank farms during tank cleaning operations, or the result of cleanup operations following oil spills.

The site is situated in the Melville North area in a low-lying wetland type area along the shoreline of Narragansett Bay, as shown in Figure 10. The area is subject to periodic flooding and lies within the 100-year flood plain (NETC Master Plan, 1980). This site is located on land which is being exscessed by the Navy and is pending final disposal by GSA.

(IAS, pg. 6-34)

2.6.2 Geology

Very little site-specific geologic or hydrologic information is available for the Melville North Landfill because no borings were drilled or wells installed at the site. Immediately north of the landfill is a swampy area. This indicates that this portion of the shore is somewhat protected from erosion and that silty muck soils may be present at the site. The silty sediments encountered in the bay at this location also indicate a low-energy environment; however, towards the south end of the landfill there is a protrusion into the bay which may indicate that bedrock exists at the ground surface.

2.6.3 Hydrology

The topography of the land surrounding the site indicates that ground water should be flowing westerly. The swampy areas immediately north of the landfill indicate that ground water must be very near the ground surface. The presence of a shallow ground water table at the site also indicates that at least some of the refuse may be in direct contact with sea water and/or ground water.

2.7 Site 09 - Old Fire Fighting Training Area

This site was not investigated in detail during the IAS and was not studied in the CS. The site was not studied in the CS because the conclusions of the IAS stated that the site did not warrant any further action. A map of the site is presented as Figure 11. The site occupies approximately 5 acres at the northern end of Coasters Harbor Island. Presently, the site contains a child care facility and a baseball field. The only unique topographic features at the site are two soil mounds; one that is approximately 15 to 20 feet high located in the center of the site, and another that is approximately 5-foot high located between the baseball field and the western shoreline.

2.7.1 History

This site was used from World War II to 1972 as a fire fighting training area. A 1943 construction drawing for the Fire Fighting Training Area shows how it appeared when operational. The site details from the 1943 drawing are provided on Figure 12. It is believed that the two buildings labeled "Carrier Compartment" had a water/oil mixture injected into them which was set on fire

for fire fighting practice. Underground piping carried the water/oil mixture to the buildings and from the buildings to the oil-water separator shown on the figure.

2.7.2 Geology

On May 19, 1987, three soil borings were drilled to bedrock as part of a design program to expand the child care facility. The boring logs indicate that bedrock is composed of sandstone, and was encountered at depths of 5.5 to 10.2 feet. The overlying unconsolidated material was identified as fill, comprised primarily of sand. The boring logs did not indicate that ground water was encountered at the site during the investigation; however, visible oil contamination was encountered in two borings (Nos. 1 and 2) at a depth of 5.5 feet. The locations of the borings are shown on Figure 13. The child care building expansion program was abandoned after the oil contamination was discovered at the site.

2.7.3 Hydrology

No perennial or ephemeral streams are apparent on the site. Therefore, surface runoff probably drains directly into the bay as sheet flow. Since the boring logs did not indicate that ground water was encountered in the overburden materials, ground water is probably present in the underlying sandstone. Usually, oceanic islands have a lens of fresh water on top of salt water. The same is probably true for Coasters Harbor Island on which the site is located (see Figure 2). The ground water at the site should discharge into the bay and harbor.

2.8 Site 12 - Tank Farm Four

2.8.1 History

Tank Farm Four was studied in both the IAS and the CS. The following sections describe the site-specific history, geology and hydrology. A site map for Tank Farm Four is presented as Figure 14.

Tank Farm Four was used for the storage of diesel and fuel oil and consists of twelve 60,000-barrel underground storage tanks. Disposal at the site was from World War II until the mid-1970's. The tank bottom sludge, obtained during cleaning operations, was disposed of directly onto the ground in the vicinity of the tank being cleaned. Between 100,000 and 190,000 gallons of oil sludge, which is a hazardous waste in Rhode Island, was disposed of at this site. The

sludge is no longer evident on the surface but probably covered the entire Tank Farm. This site is located within one quarter mile of Narragansett Bay. This site is on land which is being excessed by the Navy.

(IAS, pg 2-8)

2.8.2 Geology

Two wells were installed at the site by Clarence Welti Associates, Inc. under contract to Loureiro Engineering Associates during the CS. Figure 15 shows the locations of the wells. The well borings were drilled to depths of 25 feet (No. 10) and 31.5 feet (No. 11). The well boring logs indicate that the surficial deposits are mostly silt with sand layers. Although shale chips were recovered in the split spoon samples, neither competent nor weathered shale was encountered in either of the borings. It is not clear if the unconsolidated sediments were till or outwash deposits.

2.8.3 Hydrology

Ground water flow direction is controlled by the site topography and the orientation of discharge areas. The site topography would indicate westward ground water flow, while the orientation of the bay shoreline would indicate northwestward ground water flow. If Norman's Brook is a significant ground water discharge area, ground water flows southwestward from the tank farm. Since only two wells were installed at the site, it is not possible to define the orientation of the water table surface; however, the fact that water levels in monitoring well 11 are at a lower elevation than in monitoring well 10 indicates that at least a component of the ground water flow direction is towards the southwest. The recovery times for ground water levels during well development were 35 minutes for both wells.

2.9 Site 13 - Tank Farm Five

Tank Farm Five was studied during the IAS but not during the CS; however, two of the tanks at the site, Numbers 53 and 56, were examined further as part of a tank closure study conducted from 1985 to 1986 by Environmental Resource Associates (ERA) of Warwick, Rhode Island. In addition, Tibbets Engineering Corporation (Tibbets) of New Bedford, Massachusetts, sampled the contents of the tanks at Tank Farm Five during 1983. A map of the site is presented as Figure 16.

2.9.1 History

The site was used for the storage of diesel and fuel oil and consisted of eleven 60,000-barrel underground storage tanks. Disposal at this site has been from World War II until the mid-1970's. The tank bottom sludge, obtained during cleaning operations, was disposed of in a burning pit. This burning pit had steel sides and a sand bottom.

The sludge was placed in the pit and burned. Between 100,000 and 175,000 gallons of oil sludge were disposed of at this site. This oil sludge is considered a hazardous waste in Rhode Island. This is located within 1,000 feet of Narragansett Bay. With the exception of Tanks 53 and 56, this site is being excessed by the Navy.

(IAS, pg. 2-8)

2.9.2 Geology

Information on the geology of Tank Farm Five was gathered from two sources: a 1945 diagram prepared for the tank design plans and the ERA tank closure plan for Tanks 53 and 56. Thickness of surficial deposits at the site range from 7 to 21.5 feet. The boring logs from the tank closure investigation indicate that 5 to 10 feet of sand and gravel, presumably fill, overlies 2 to 12 feet of glacial till. Greatest depths to bedrock were found at the hilltop on which Tank 59 is located. The bedrock at the site consists of shale, schists, schistose sandstone, and vein quartz. Bedding planes and fracture orientation are generally horizontal. Bedrock core recoveries were low ranging from less than 40% to a maximum of 60%.

2.9.3 Hydrology

Surface runoff in the western portion of Tank Farm Five is towards the west and Narragansett Bay, while runoff in the central and eastern portion of the site is northward to Gomes Brook. The approximate watershed boundary is a slight ridge trending east to west across Tanks 51 and 59.

Although its location cannot be precisely determined based on the available data, a ground water divide appears to exist on the site. Because the water table surface usually follows the topography, the ground water flow patterns probably parallel the surface runoff. The water levels in the six monitoring wells installed around Tank 53 indicate that ground water is flowing towards the northwest (see Figure 17), while the 1945 construction diagram indicates that ground water in the central and eastern portion of the site is flowing towards Gomes Brook.

As a part of the tank closure investigation, ERA installed four monitoring wells in the ring drains for two tanks at the site, Numbers 53 and 56. ERA later installed five monitoring wells downgradient and one well upgradient of Tank 53. Most of these wells were completed at an approximate depth of 35 feet; however, wells 3A and 3B were installed in the same borehole at depths of 33 and 49 feet, respectively. Most of these wells were constructed with 20 feet of screen which extended above the water table; however, well 3B has only 10 feet of screen which is all below the water table.

The wells were hydraulically tested using constant head techniques with packers spaced 5 feet apart. Generally, the constant head technique is not appropriate for materials with hydraulic conductivities on the order of shale (10^{-7} to 10^{-11} cm/sec (Freeze and Cherry, 1979)). Therefore, most of the tests yielded no measurable result; however, slightly permeable (3×10^{-6} to 10^{-5} cm/sec) zones were found in each well. These permeable zones are probably caused by fractures or fracture zones in the shale. Because of the higher permeability of fracture zones, ground water and contaminants will move much faster in these zones than in the rest of the rock matrix.

Based upon the ground water elevation data from the ERA investigation, the horizontal hydraulic gradient in the vicinity of Tank 53 is 2×10^{-2} ft/ft. Assuming a typical porosity for shale of 5%, the average linear ground water velocity in the most permeable fracture encountered would be approximately 25 feet/year. Contaminant velocities would be somewhat less because of the adsorption characteristics of the shale.

3.0 HISTORY OF RESPONSE ACTIONS

This section presents a brief chronology of the interaction between the Rhode Island Department of Environmental Management (RIDEM), other regulators, and the NETC concerning environmental issues at the Naval base. In addition, a summary of the analytical results and environmental interpretations based on the results is presented for each site. Finally, a brief overview of additional data requirements is provided for each site.

3.1 Chronology of Regulatory and Navy Actions

The following chronology pertinent to the NETC site investigations was obtained from the IAS report, the Draft Tank Closure Plan for Tanks 53 and 56, and a review of information in RIDEM files:

- Mid-1960's - burning of oil tank bottom sludges discontinued because of air pollution regulations.
- Unknown Date - all of NETC shoreline closed to shellfishing due to concerns about bioaccumulation of contaminants in Narragansett Bay from sites on the facility.
- Post 1971 - required scrubbers were installed on the Navy's classified document incinerator.
- September 11, 1980 - the Navy Assessment and Control of Installation Pollutants (NACIP) program was initiated. The purpose of the program is to systematically identify, assess, and control environmental contamination from past use and disposal of hazardous substances at Navy and Marine Corps installations. (Note: This study is being conducted under the Department of Defense Installation Restoration Program.)
- 1982 - the RIDEM adopted hazardous waste regulations which classified waste oil as a hazardous waste.
- March 1983 - Initial Assessment Study (IAS) of NETC completed.
- 1984 - the Navy ceased using Tanks 53 and 56 at Tank Farm Five for waste oil storage.
- 1986 - the RIDEM implemented new regulations for the operation and closure of underground storage tanks used to hold oils and hazardous materials.
- May 1986 - Confirmation Study Report (CS) on the NETC was completed.
- 1988 - Tank Closure Plan for Tanks 53 and 56 located at Tank Farm Five completed and closure option selected for implementation.

3.2 Summary of Environmental Investigations

Two phases of environmental samples were collected during the CS for McAllister Point and Melville North landfills and Tank Farm Four: the Verification Step, followed by the Characterization Step. In addition, ground water samples were collected at Tank Farm Five as part of the closure plan for Tanks 53 and 56. No environmental samples were collected for analyses at the Old Fire Fighting Training Area.

3.2.1 Site 01 - McAllister Point Landfill

The verification and characterization phases of environmental sampling were conducted at McAllister Point Landfill during the CS. During the Verification Step, five sediment and five blue mussel samples were collected adjacent to the site from Narragansett Bay, along with three landfill leachate samples and one composite soil sample (collected from six locations on the landfill cover) (see Figure 18). In addition, background samples for the sediment and mussels were collected 6 miles north of the site on the west shore of Aquidneck Island and 4 miles southwest of the site on the east shore of Conanicut Island. The bay sediment and mussel samples were analyzed for PCBs and priority pollutant metals, while the composite soil sample and leachate samples were analyzed for all priority pollutants.

Low concentrations of contamination were detected in the one composite surface soil sample collected from the site. The low levels detected in the sample included detectable concentrations for several metals (Cr, Cu, Pb, Ni, Zn), total cyanide (0.047 parts per million (ppm)) and total phenol (0.027 ppm). No priority pollutant volatile organics, semi-volatile organics, or pesticides/PCBs were detected in the soil sample. Overall, these results are not surprising since the composite sample was collected from the fill used to cap the landfill, rather than from the refuse material or surrounding surface soils.

The two leachate springs sampled during the investigation were located along the western edge of the landfill (Nos. 07, 08). Spring number 08 produced a greater flow of leachate than spring number 07. Spring number 08 was sampled twice during the investigation, once during wet weather and again during dry weather. Spring 07 was sampled once during wet weather. All leachate samples contained detectable levels of cadmium (0.028 to 0.058 ppm)

total cyanide (0.017 to 0.867 ppm) and total phenols (0.006 to 0.016 ppm). Spring number 08 also contained detectable levels of chromium during both the wet and dry sampling events (0.028 parts per billion (ppb) and 0.032 ppb, respectively). The sample from spring number 07 was also found to contain two volatile organic compounds, ethylbenzene (30 ppb) and toluene (26 ppb).

The EPA has established standards for salt water quality under the Clean Water Act. These standards apply to the homogenized water quality offshore from a discharge point rather than to the quality of the discharge (in this case the leachate). Although the Clean Water Act standards do not apply directly to the leachate sample results, the standards do provide a relative framework in which to evaluate the leachate sample results. Also note that the federal salt water standard for cyanide applies to free cyanide rather than total cyanide as measured in this study. The applicable salt water standards and detected leachate concentrations are provided below.

<u>Parameter</u>	<u>Standard (ppb)⁽¹⁾</u>		<u>Leachate Concentration (ppb)</u>		
	<u>Acute</u>	<u>Chronic</u>	<u>07</u>	<u>08 (wet)</u>	<u>08 (dry)</u>
Cadmium	43	9.3	28	58	54
Chromium	1,100	50	ND	28	32

ND = Not detected

(1) Salt Water Quality Standards (RIDEM, 1988).

Although the concentrations of some parameters detected in the landfill leachate samples exceeded established salt water standards, the resulting concentration of the metals in the bay water offshore from the landfill would likely be below the established salt water standards as a result of the dilution effects of the bay. It is important to note that metals and some organic compounds, such as PCBs, can accumulate in sediments and shellfish and, thereby, potentially pose a threat to human health and the environment.

Bay sediment and blue mussels were sampled from Narragansett Bay along the length of the landfill. Because no regulatory standards exist for sediment and mussels, sample results were compared to background samples. The distribution of sampling locations is shown in Figure 18. The sediment was collected within 25 feet of the shoreline and the mussels were collected from

the intertidal zone. In general, the sample results indicate that the concentration of several metals increases from north to south along the bay in both the sediment and mussel samples. At the southern end of the landfill near leachate spring number 08, sample concentrations were several times greater than upstream and background levels. The detected metal concentrations for the sediment and mussel samples are provided below.

Substrates and Metals	Sample Concentration (ppm)					Background	
	Sample Number					Sample Number	
	09	10	11	12	13	N1	N2
Sediment:							
Chromium	7.5	7.0	6.3	17.5	14.8	11.5	8.0
Lead	70.0	77.5	57.5	900	327	27.5	6.8
Copper	28.3	133.2	153.4	1,455	655	18.3	10.3
Nickel	19.3	22.0	32.8	64.0	55.5	21.3	11.3
Mussels:							
Copper	6.0	6.4	9.2	12.2	28.3	7.2	4.3

The above data indicates that a metals contamination problem exists in sediments and mussels in the bay near the site. The sediment and mussel samples were not analyzed for organics, except for PCBs. While no PCBs were detected in the sediments, they were detected in all mussel samples except sample number 10. The PCB levels detected in the mussel samples (0.29 to 0.38 ppm) did not vary according to location and were not higher than the established background sample results (0.36 and 0.37 ppm). The PCB data suggest that the PCBs in the mussels are due to general, widespread contamination in Narragansett Bay rather than from the site.

A second phase of fieldwork, the Characterization Step, was conducted in order to further delineate the sediment and mussel metals contamination around the southern end of the landfill and to investigate the ground water passing through the landfill. Mussels were resampled at stations 12 and 13 and an additional mussel sample was collected further south from a new station (No. 14). Sediment samples were collected further out into the bay to delineate the offshore migration of metals from the landfill. Two wells were placed in the landfill and a third well was installed in an upgradient location off of the site. The sample locations for the Characterization Step are shown on Figure 19.

The analytical results for the mussel samples collected during the Characterization Step differed from the prior mussel sample results in that four metals, lead, copper, chromium, and nickel, were detected in the second round of mussel samples instead of just one, chromium. The detected metal concentrations for the mussel samples are provided below.

Sample Number:	Mussel Sample Concentration (ppm)					
	<u>12</u>	<u>13</u>	<u>14</u>	<u>BG-1</u>	<u>BG-2</u>	<u>BG-2 (Dup)</u>
<u>Metal</u>						
Chromium	3.5	1.0	1.4	1.1	2.8	1.4
Lead	19.9	7.5	19.7	4.9	3.8	5.2
Copper	20.6	9.2	14.1	6.8	8.2	5.4
Nickel	6.6	4.0	4.4	4.9	5.1	4.9

Dup = Duplicate Sample

The change in mussel contaminant concentrations between the two sampling events may be due to seasonal changes; the Verification Step was conducted in November 1983 and the Characterization Step was conducted in September 1984. Alternatively, some of the mussels collected in the Verification Step may have purged more metal-laden sediments from their bodies after collection than did those collected in the Characterization Step. The change in concentrations may also be due to the following sample analytical deficiencies: the quality assurance data indicates a fairly low degree of precision for the above results because the blind duplicates for the samples differ from each other by as much as 50%, and lower detection limits were achieved for one of the metals (chromium) in the second phase. In either case, the data indicates that contamination from McAllister Point Landfill has migrated at least as far south as station 14 (see Figure 19).

The analytical results for the sediment samples collected during the Characterization Step show a clear pattern of decreasing metals concentrations away from the landfill. The detected metals concentrations for the sediment samples is provided below.

Sample Number:	Sediment Sample Concentration (ppm)						
	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>
<u>Metal</u>							
Chromium	22.0	14.3	12.7	8.7	17.1	14.8	14.3
Lead	267	78.2	44.0	21.5	34.9	33.6	32.3
Copper	890	63.4	33.2	20.8	22.8	25.4	16.6
Nickel	86.6	20.3	17.2	11.5	16.9	17.8	14.2

A comparison of the sediment metal concentration results for those samples collected near the southern end of the landfill is provided below.

<u>Sample Location</u>	<u>Sediment Concentrations Range (ppm)</u>			
	<u>Chromium</u>	<u>Lead</u>	<u>Copper</u>	<u>Nickel</u>
Near-shore (Stations 12 to 14)	14 - 22	267 - 900	655 - 1,455	55 - 87
Off-shore Stations 15 and 16)	12 - 14	44 - 78	33 - 63	17 - 20
Out to 400' from shore (Stations 17 to 20)	9 - 17	21 - 35	17 - 21	11 - 18
Controls (Stations N-1 and N-2)	8 - 12	7 - 28	10 - 18	11 - 21

Additional sediment and mussel sampling at McAllister Point was conducted by the U.S. Army Corps of Engineers (U.S. ACE) in January 1988. Mussel and sediment samples were collected from seven locations within the intertidal zone; six samples (numbers 1-6) were collected adjacent to the landfill and one sample (number 7) was collected 695 feet to the north as a control sample. Figure 20 shows these sediment/mussel sampling locations.

The U.S. ACE sediment sample results show that the levels of metals, PCBs and petroleum hydrocarbons detected in the sediments adjacent to the landfill were consistently at least one order of magnitude greater than those detected at the control point. The mussels sample analyses found copper and chromium concentrations in some of the mussels samples near the southern end of the landfill significantly above the control sample. PCBs were detected at elevated concentrations in mussel sample numbers 1 and 4.

Substrate and Compound	Sediment Concentration (ppm)						Control Sample 07
	Sample Number						
	01	02	03	04	05	06	
Sediment:							
Cadmium	3	ND	11	12	7	8	ND
Chromium	57	69	98	94	2,190	86	11
Copper	1,370	556	25,000	1,220	2,810	3,981	16
Nickel	1,340	90	225	154	1,310	440	33
Lead	3,130	814	4,410	2,290	587	3,680	1,760
Zinc	2,440	814	2,410	1,790	587	1,760	67
PCBs	0.49	0.66	2.03	1.58	0.07	0.86	0.01
Petroleum							
Hydrocarbons	480	300	400	330	170	1,100	30

Substrate and Compound	Sediment Concentration (ppm)						
	Sample Number						Control Sample 07
	01	02	03	04	05	06	
Mussels:							
Chromium	ND	ND	ND	2.0	ND	ND	ND
Copper	1.4	2.8	1.6	1.5	ND	ND	ND
Zinc	18	23	23	18	16	14	15
PCBs	0.12	0.05	0.01	0.30	0.03	0.05	0.04

In summary, all of the sediment and mussel data show that significant metals, PCB and petroleum hydrocarbon contamination is emanating from the landfill. Contamination may be localized around the southern end of the landfill because the point provides protection on the leeward side against rapid sediment erosion. In addition, the longer residence time on the leeward side of the point would allow more time for contamination to accumulate in sediments and mussel in the area.

Ground water samples were collected from the three wells during four sampling events. Elevated concentrations of lead, copper, and total phenols were detected in the two downgradient well ground water samples. No other priority pollutants were detected in any of the ground water samples. The parameters and concentrations detected in the ground water samples are provided below.

Parameter	Concentration (ppm)					
	Wells Downgradient of Landfill			Well Upgradient of Landfill		Ground Water Standard
	(Stations 21 and 22)			(Station 23)		
Cyanide	<0.005	to	0.013	<0.005	to 0.009	-
Lead	<0.04	to	1.58	<0.04	to 0.10	0.050 ⁽¹⁾
Copper	0.07	to	1.04	<0.04	to 0.11	1.0 ⁽¹⁾
Chromium	<0.02	to	0.22	<0.02	to 0.09	-
Nickel	<0.04	to	0.30	<0.04	to 0.19	0.0134 ⁽²⁾
Mercury	<0.0002	to	0.0007	0.0008		0.002
Zinc	0.2	to	0.5	0.082		5.0 ⁽²⁾
Chlorides	1.3	to	795	1.6	to 3.8	-
Phthalates	<0.010	to	0.064	0.366	to 0.931	-
Phenols	0.013	to	0.021	0.007		3.5 ⁽²⁾
pH (std. units)	6.41	to	7.01	5.84	to 6.18	-
All Other Priority Pollutants	None above Detection Limit					

(1) Safe Drinking Water Act MCLs.

(2) Clean Water Act, Water Quality Criteria for Human Health.

The above results indicate that metal contamination exists in the site ground water. Because all of the wells are screened at least 6 feet below the water table, other less dense or immiscible pollutants may be present in the ground water at the water table (e.g., solvents), despite the evidence presented in the analytical results.

3.2.2 Site 02 - Melville North Landfill

Verification and Characterization Steps were conducted under a Confirmation Study at the Melville North Landfill. The Verification Step involved collecting three sets of sediment and mussel samples adjacent to the site from Narragansett Bay and one composite soil sample from a mound of oil saturated deposits observed at the site (see Figure 21).

The sediment and mussel samples were analyzed for PCBs and total metals. The detected sample concentrations are provided below.

Substrates and Parameters	Sample Concentration (ppm)				
	Sample Number			Background Sample Number	
	04	05	06	N-1	N-2
Mussels:					
PCBs	0.08	0.35	0.03	0.36	0.37
Sediment:					
Chromium	4.3	9.3	5.8	11.5	8.0
Lead	2.3	7.5	5.8	27.5	6.8
Copper	4.0	16.0	5.5	18.3	10.3
Nickel	8.3	10.8	10.3	21.3	11.3

The above results indicate that metals and PCB contamination do not appear to be present in the mussels and sediments in the bay adjacent to the site. As discussed in connection with the McAllister Point Landfill, the PCB concentrations in the mussel samples appear to be the result of general, area-wide bay contamination as is evident from the similar levels observed in background samples. According to maps provided in the CS report, the background samples N-1 and N-2 were collected from Narragansett Bay; N-1 from approximately 2 miles north of the site along the Portsmouth shoreline, and N-2 from approximately 7 miles south of the site along the eastern shoreline of Conanicut Island.

Unlike the McAllister Point Landfill, the Melville North Landfill does not physically protrude into the bay. As previously stated, it is believed that this physical feature of McAllister Point protects the sediments against erosion and may enhance the bioaccumulation of metals in sediments and mussels in that area. Therefore, it is possible that the Melville North landfill is emitting contaminants into the bay; however, the currents may be transporting the contaminants and affected sediments away from the site.

The composite soil sample from the oil-saturated waste deposits contained 32,508 ppm of petroleum-based hydrocarbons, 60 ppm of lead, and no detectable PCBs. The petroleum-based hydrocarbon concentration represents over 3% of the waste deposits by weight.

The Characterization Step at the site involved excavating 3-foot deep holes around the perimeter of the oily waste deposits. The subsurface soil was inspected in these pits and no visual evidence of lateral or downward migration of oil from the waste deposits was observed in the area. No samples were collected from the test holes for laboratory analyses.

3.2.3 Site 09 - Old Fire Fighting Area

Little is known about the environmental condition of the Old Fire Fighting Training Area because no environmental investigation or sampling has been conducted at the site. The surface soil appears visually clean but no sample analytical results exist to confirm this observation. As mentioned in Section 2.7, soil borings, which were drilled to bedrock as part of a geotechnical study for a building expansion, encountered oil approximately 5 feet below the ground surface. Figure 13 shows the locations of the borings. The results of the study indicate that oil was encountered in borings 1 and 2.

The IAS report speculates that waste oil was used at the site as the fuel for the training fires. If this is the case, the potential for metals and chlorinated solvent contamination at the site is significant. This statement is based on the type of contaminants found around the waste oil storage tanks at Tank Farm Five. A ground water lens large enough to be usable for water supply probably does not exist on Coasters Harbor Island because it is small and low-lying. However, the potential exists for the oil to migrate into the

bay. The oil may also pose a hazard to utility workers and others who may have to excavate in the area.

3.2.4 Site 12 - Tank Farm Number Four

Verification and Characterization Steps were conducted at the Tank Farm Four site. The Verification Step involved collecting near-surface composite soil sample, a surface water sample, and a stream sediment sample (see Figure 22). The soil sample was collected to determine the presence of residual oils from the sludge- burning operations which reportedly occurred at the site. Lead (3.25 ppm) and oil/grease (216 ppm) were detected in the soil sample. The sample was not analyzed for any other parameters. The soil sample analytical results indicate that soil contamination exists at Tank Farm Four probably as a result of prior sludge-burning operations. The stream water and sediment samples both contained petroleum-based hydrocarbons, 3.6 ppm and 478 ppm, respectively. The field sampling personnel observed that the source of water flowing in the unnamed swale from which the surface water sample was collected appeared to be ground water seeping from the hillside. Therefore, this indicates that the ground water in this area of the site is likely contaminated with hydrocarbons. No lead was detected in either the surface water or sediment samples. The surface water and sediment samples were not analyzed for any other parameters.

The Characterization Step at the site involved collecting water samples from 6 of the 12 oil tanks and ground water samples from two downgradient on-site monitoring wells (see Figure 23). The tank water samples were analyzed for total suspended solids (TSS), lead, pH, ammonia, biological oxygen demand (BOD), and petroleum-based hydrocarbons (PBHCs). The results of the tank water sample analyses are presented below.

Sample Concentration (ppm)							
Tank Number	Station Number	pH	Lead	Total Suspended Solids	Ammonia-Nitrogen	Biochemical Oxygen Demand (5-day)	Petroleum-based Hydrocarbons
37	12	7.17	<0.04	79.2	0.76	46	7.5
38	15	7.60	<0.04	25.6	0.89	12	4.0
39	13	7.85	<0.04	7.2	0.74	3	7.3
45	14	7.40	<0.04	99.6	0.48	20	14.2
46	16	7.50	<0.04	29.2	0.67	17	21.9
47	17	7.60	<0.04	37.6	0.48	7	36.7

The above tank water sample results indicate that low concentrations of PBHCs exist in the tank contents and that the levels of TSS and BOD vary throughout the tanks sampled.

The ground water was sampled four times between November 1984 and January 1985 and was analyzed for lead and PBHC. The ground water samples from both monitoring wells contained detectable concentrations of lead and PBHC. The results of the ground water sample analyses are presented below.

<u>Station Number</u>	<u>Sampling Date</u>	<u>Sample Concentration (ppm)</u>	
		<u>(1) Lead</u>	<u>Petroleum-Based Hydrocarbons</u>
10	11/20/84	0.04	<1.0
	12/17/84	<0.04	3.3
	01/07/85	<0.04	2.7
	01/28/85	<0.04	<1.0
11	11/20/84	0.06	1.9
	12/17/84	<0.04	12.3
	01/07/85	0.10	3.6
	01/28/85	<0.04	2.3

(1) Safe Drinking Water MCL for Lead = 0.50 ppm.

The above ground water analytical results indicate that lead and PBHC contamination exist in the site ground water.

The position of the monitoring wells is not optimal for intercepting a contaminant plume from Tank Farm Four (Figure 23); the land surface and the hydraulic heads measured in the two monitoring wells indicate that ground water is flowing due west or south of west. Thus, given the location of the probable sources of the ground water contamination (i.e., the underground storage tanks) the two monitoring wells are to the side of the probable contaminant pathway. In support of this interpretation, monitoring well number 11, which is closer to the probable plume position, showed higher contaminant concentrations during each sampling event.

3.2.5 Site 13 - Tank Farm Number Five

A CS was not conducted at Tank Farm Five, therefore, an environmental assessment for the site is not available. Although, as mentioned previously in Section 2.9, two studies were completed concerning two of the underground

storage tanks (USTs) at the site; a 1983 study on the contents of two of the USTs at the site, and a 1985-86 study required by the RIDEM for the closure of the same two tanks. As previously mentioned in Section 2.9.1, these two tanks were used for waste oil storage after the other tanks at the site were taken out of service.

The 1983 tank investigation involved the sampling of tank numbers 53 and 56. Samples of the floating oil layer, water, and bottom sludge were collected from each of the two tanks. Although relatively homogeneous oil was floating on the water surface and relatively oil-free water was present in the bottom 2 feet of the water column, the intervening 28 feet of water appears to consist of an oil-water emulsion. Samples were collected at 1-foot intervals throughout each tank with a point sampler which consisted of a cylinder open at both ends which could be closed by dropping a weight down a connecting cable. It was noted in the study report that the viscous nature of the floating layer may have fouled the sampler as it was lowered through the oil. It was also noted that determining the presence of oil at intermediate depths was difficult because the floating layer appeared to interfere with the collection of the water samples. Two oil and two water samples were composited from several of the 1-foot point samples. One oil sample came from only the top floating oil layer, while the other consisted of oil retrieved from thin oil intermediate layers located within the water column. Likewise, one water sample was composited from the bottom 2 feet of the water column, while the other water sample was composited from intermediate levels of the water column. The samples were analyzed for arsenic, lead, and several volatile organic compounds. In the following table, the pure oil and pure water are designated with an "A", preceded by an "O" and "W", respectively, while the samples separated and composited from mixtures are designated with a "B":

		Sample Concentration (ppm)			
Tank Sample Number:		(1) 53-O-A	(1) 53-O-B	(2) 53-W-A	(2) 53-W-B
<u>Parameter</u>					
Metals:					
Lead		53	53	0.52	0.13
Volatile Organic Compounds:					
Vinyl chloride		ND	ND	0.071	0.194
Methylene chloride		520	24	0.330	1.150
Trichlorofluoromethane		15	ND	ND	ND
1,1-Dichloroethylene		182	75	0.190	0.148
1,1-Dichloroethane		ND	ND	ND	0.134
trans-1,2-Dichloroethylene		152	111	3.025	2.530
1,2-Dichloroethane		51	11	ND	ND
1,1,1-Trichloroethane		1,230	344	ND	0.739
Trichloroethylene		1,300	362	ND	ND
Tetrachloroethylene		340	206	ND	0.072

		Sample Concentration (ppm)			
Tank Sample Number:		(1) 56-O-A	(1) 56-O-B	(2) 56-W-A	(2) 56-W-B
<u>Parameter</u>					
Metals:					
Lead		45	45	0.39	0.07
Volatile Organic Compounds:					
Vinyl chloride		ND	ND	0.440	0.187
Methylene chloride		90	18	0.440	0.180
1,1-Dichloroethylene		3	4	ND	ND
trans-1,2-Dichloroethylene		ND	36	0.630	ND
Chloroform		ND	4	0.100	ND
1,2-Dichloroethane		6	5	ND	ND
1,1,1-Trichloroethane		24	30	ND	ND
Trichloroethylene		28	29	ND	ND
Tetrachloroethylene		16	23	0.110	0.540

ND = Not Detected

(1) Oil Sample

(2) Water Sample

The above tank sample results show that the chlorinated solvents are much more concentrated in the oil layer than in the water. This is likely due to the hydrophobic nature of these solvents. The hydrophobicity of the solvents also causes them to be adsorbed by organic matter on the aquifer materials as they are being carried by the ground water (Walton, 1985).

The tank sludge samples were analyzed for eight metals and all metals except arsenic and selenium were detected in the samples. The results of the tank sludge sample analyses are presented below.

<u>Metals</u>	<u>Sludge Sample Concentration (ppm)</u>	
	<u>Tank 53</u>	<u>Tank 56</u>
Arsenic	ND	ND
Barium	1,244	804
Cadmium	13.7	17.3
Chromium	212	248
Lead	22,500	14,700
Mercury	1.6	0.83
Selenium	ND	ND
Silver	5.9	21.0

ND = Not Detected

Although the concentrations of total metals in the sludge were quite high, the potential for the metals to leach from the sludge and migrate with the water into the environment is not known. Given that the metals would more likely leach from the sludge under acidic conditions, the results of the pH measurements conducted on the tank water (pH ranged from 5.6 to 8.1) tend to indicate that the metals should remain adsorbed to the solid fraction. Leachate tests were not performed on any of the sludge samples.

During 1985, samples were collected from the floating oil in Tanks 53 and 56. The samples were analyzed for volatile and semi-volatile organic compounds, metals, and other miscellaneous parameters. Hundreds of parts per million of aromatic and chlorinated organic compounds were detected in the oil samples. Copper, lead, mercury, nickel, and zinc were also detected in the oil samples at significant concentrations. The oil in the tanks is the probable source of dissolved constituents in the water.

The tank closure investigation involved two phases of field work. The first phase consisted of installing two monitoring wells on the east and west side of each tank in the fill material surrounding the perimeter of each tank. The wells were sampled in October 1985 and analyzed for metals and volatile organics. Although the analytical results detected no metals contamination, significant concentrations of aromatic and chlorinated hydrocarbons were detected around Tank 53. The results of the ground water sample analyses are presented below.

Parameter	Sample Concentration (ppm)				
	MW-53W	MW-53E	MW-56W	MW-56E	Standard ⁽¹⁾
Metals (soluble):					
Arsenic	<0.01	<0.01	<0.01	<0.01	0.05
Barium	<0.5	<0.5	<0.5	<0.5	1.0
Cadmium	0.007	<0.005	<0.005	<0.005	0.010
Chromium	<0.05	<0.05	<0.05	<0.05	0.050
Lead	<0.05	<0.05	<0.05	<0.05	0.050
Mercury	<0.0005	0.0012	0.0014	0.0008	0.002
Selenium	<0.01	<0.01	<0.01	<0.01	0.010
Silver	<0.01	<0.01	<0.01	<0.01	0.050

Parameter	Sample Concentration (ppm)				
	MW-53W	MW-53E	MW-56W	MW-56E	Standard ⁽¹⁾
Volatile Organic Compounds:					
Methylene Chloride	0.054	0.178	0.304	ND	-
trans-1,2-Dichloroethylene	0.046	0.166	ND	ND	0.27 ⁽³⁾
Chloroform	0.353	0.401	0.018	0.012	0.1
1,2-Dichloroethane	0.229	0.211	ND	ND	0.00094 ⁽²⁾
1,1,1-Trichloroethane	4.4	4.4	0.017	ND	19.0 ⁽²⁾
Trichloroethylene	0.785	1.4	ND	ND	0.0027 ⁽²⁾
Tetrachloroethylene	0.014	0.262	ND	ND	0.0008 ⁽²⁾
Benzene	0.155	0.300	ND	ND	0.005
Ethylbenzene	ND	0.374	NE	ND	2.4 ⁽²⁾
Xylenes	0.140	1.62	ND	ND	1.2 ⁽³⁾

ND = Not Detected

NE = Detection Limit Not Exceeded

(1) Safe Drinking Water Act MCLs.

(2) Clean Water Act, Water Quality Criteria for Human Health.

(3) Safe Drinking Water Act Health Advisories, 10-day.

The above ground water sample results indicate that low level metals contamination (Cd and Hg) and high level volatile organics contamination is present in the ground water near Tanks 53 and 56.

The second phase of the tank closure investigation field work addressed whether a contaminant plume is emanating from Tank 53. Figure 17 shows the location of all of the monitoring wells that were installed during the tank closure investigation. Monitoring well number 3 is actually two wells in one borehole screened at depths of 13 to 33 feet and 39 to 49 feet. The wells were sampled during October 1986 and analyzed for volatile organic compounds.

Parameter	Well Number:	Concentration (ppm)						Standard ⁽¹⁾
		1	2	3D	3S	4	5	
Volatile Organic Compounds:								
trans-1,2-Dichloroethylene		ND	0.003	0.026	0.001	ND	ND	0.27 ⁽³⁾
Chloroform		ND	0.010	ND	0.003	0.012	ND	0.1
1,2-Dichloroethane		ND	ND	0.018	ND	ND	ND	0.00094
1,1,1-Trichloroethane		ND	0.005	0.101	0.005	ND	ND	19.0
Trichloroethylene		ND	0.001	0.035	0.002	ND	ND	0.0027
Tetrachloroethylene		ND	ND	0.002	ND	ND	ND	0.0008
Benzene		ND	ND	0.002	ND	ND	ND	0.005 ⁽²⁾
Toluene		ND	ND	0.003	ND	ND	ND	15.0
Ethylbenzene		ND	ND	0.003	ND	ND	ND	1.4
Xylenes		ND	ND	0.039	ND	ND	ND	1.2 ⁽³⁾
1,1-Dichloroethane		ND	0.002	0.002	0.004	ND	ND	-
Trichlorofluoromethane		ND	ND	0.001	ND	ND	ND	-

ND = Not Detected

(1) Clean Water Act, Water Quality Criteria for Human Health.

(2) Safe Drinking Water Act MCLs.

(3) Safe Drinking Water Act Health Advisories, 10-day.

The above ground water sample concentrations are one to two orders of magnitude less than those detected in the samples from the wells completed in the tank perimeter fill materials. The deeper well at location number 3 (3D) contained higher concentrations of contaminants than the shallow well (3S). This appears to demonstrate the propensity of the chlorinated compounds to sink. The absence of any detectable volatile organic compounds in well number 5 does not necessarily indicate that the plume has not reached that far; it may have simply sunk to a depth below the bottom of the well screen (at 26 feet) at location number 5.

In addition, the wells installed in the first phase of the tank closure were resampled in November 1986 and analyzed for volatile organic compounds. The results for these resampled wells are shown below:

	Sample Concentration (ppm)					(1)
Parameter	MW-53W	MW-53E	MW-56W	MW-56E	Standard	
Volatile Organic Compounds:						
trans-1,2-Dichloroethylene	0.400	1.100	ND	ND	0.27 ⁽³⁾	
1,1,1-Trichloroethane	0.330	0.930	ND	ND	19.0	
Trichloroethylene	0.024	0.800	ND	ND	0.0027	
Tetrachloroethylene	0.016	0.025	ND	ND	0.0008	
Benzene	ND	0.330	ND	ND	0.005 ⁽²⁾	
Toluene	ND	1.400	ND	ND	15.0	
Ethylbenzene	ND	0.150	ND	ND	1.2 ⁽³⁾	
Xylenes	0.065	0.600	ND	ND	-	
1,1-Dichloroethane	0.014	0.032	ND	ND	-	
1,1-Dichloroethylene	0.057	0.170	ND	ND	.000033	
Bromodichloromethane	0.049	0.470	ND	ND		

ND = Not Detected

NE = Detection Limit Not Exceeded

(1) Clean Water Act, Water Quality Criteria for Human Health.

(2) Safe Drinking Water Act MCLs.

(3) Safe Drinking Water Act MCLs Health Advisories, 10-day.

Again, significant concentrations of volatile organic compounds were detected in the ground water samples, although the compounds had changed. Methylene chloride, chloroform and 1,2-dichloroethane were not detected during the second ground water sampling event, while toluene, 1,1-dichloroethane, 1,1-dichloroethylene and bromodichloromethane were detected during the second sampling event and not in the first round. With the above exceptions, the concentrations and compounds detected during both events, were similar. Annual fluctuations in hydrogeological parameters (e.g., ground water levels, direction of flow, etc.), sampling techniques and laboratory contamination may account for the variability in results between the two ground water sampling events.

All of the ground water sampling information indicate that a number of volatile organic compounds are present in the ground water around tank 53 and that a plume of ground water contamination is moving downgradient of the tank.

During the 1985 tank closure investigation, water samples were collected from each of the tanks at Tank Farm Five. The samples were analyzed for both aromatic and chlorinated volatile organic compounds, as well as priority pollutant metals, and other miscellaneous parameters (e.g., pH, BOD, TSS). No

organic compounds were detected in the water samples collected from three of the tanks, numbers 49, 58, and 59. Tank 54 had only 42 ppb of total volatile organics detected in its water sample and tank 56 had detectable concentrations levels of chloroform detected in its water sample. Several hundreds of parts per billion of chlorinated and aromatic organic compounds were detected in the water samples from the remaining tanks, numbers 50, 51, 52, 53, and 55. The source of chlorinated solvents in the non-waste oil tanks (all the tanks except numbers 53 and 56) is unknown. The presence of these solvents, many of which are considered potential human carcinogens, increase the potential for serious ground water contamination, if the tanks are discovered to be leaking.

All of the tank water samples contained detectable concentrations of copper, 0.02 to 0.07 ppm, and zinc, 0.01 to 0.12 ppm. Most tank water samples did not contain detectable concentrations of other metals, except tanks numbers 51, 53, and 56. The water samples from these tanks contained cadmium and lead at concentrations near the analytical detection limit.

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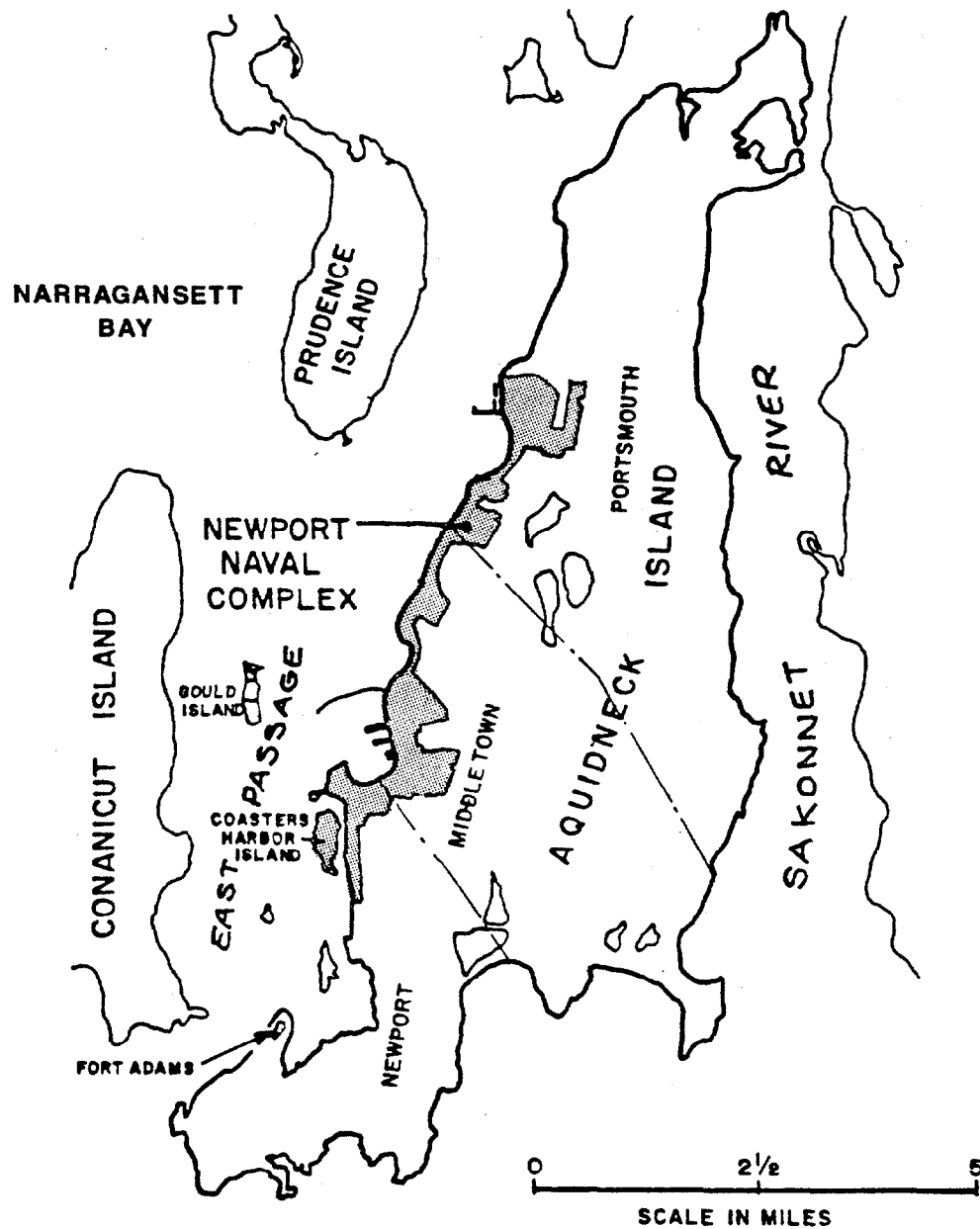
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FIGURES



SOURCE: INITIAL ASSESSMENT STUDY
(ENVIRODYNE, 1983)

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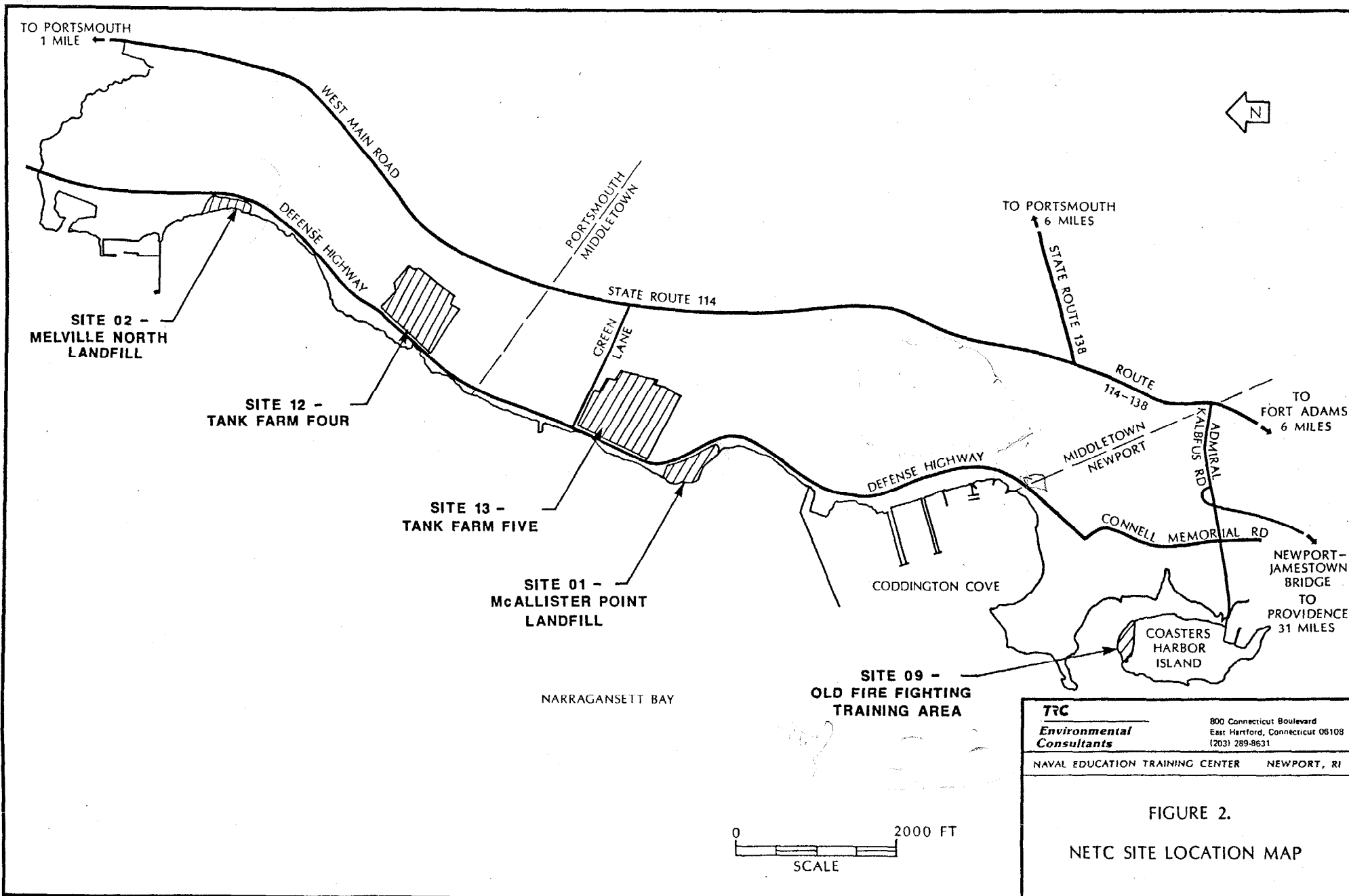
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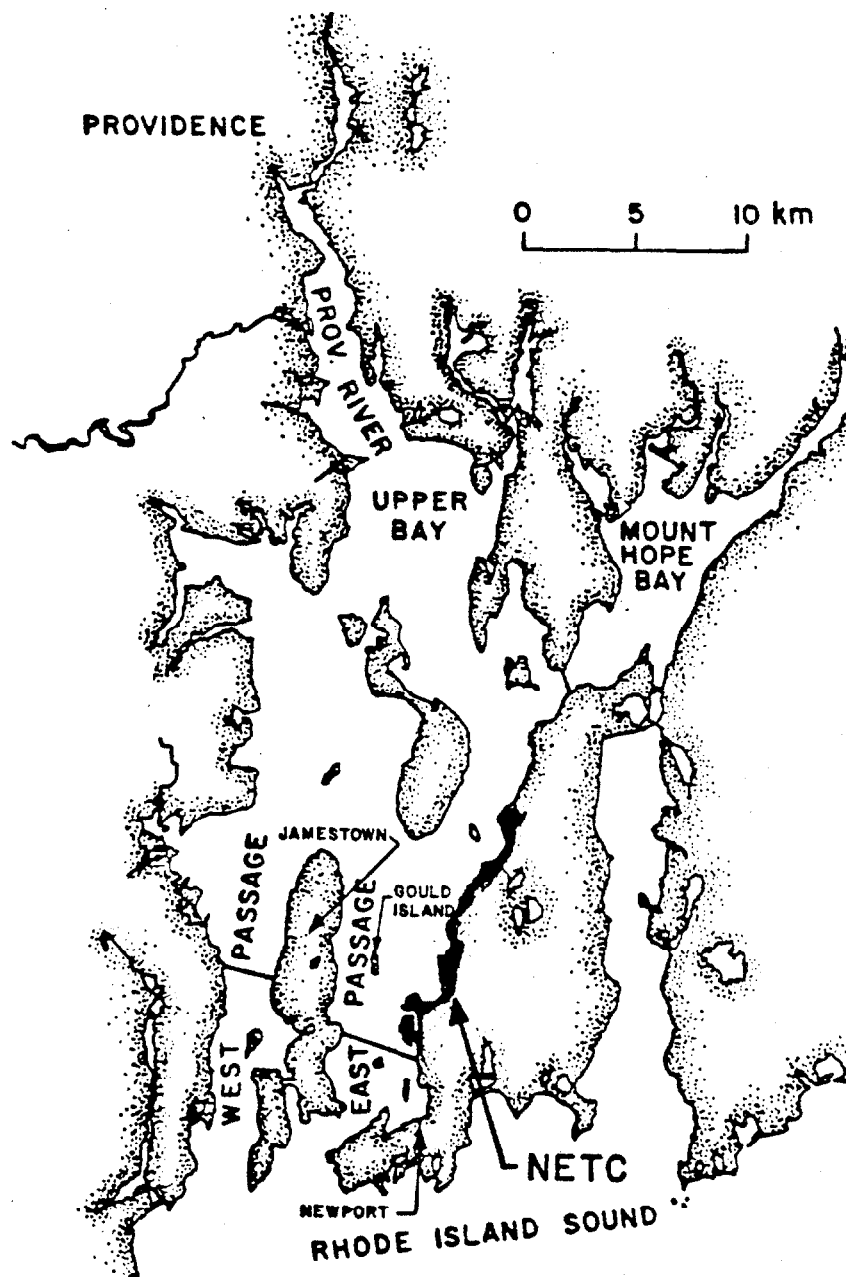
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FIGURE 1.

NAVAL EDUCATION AND
TRAINING CENTER VICINITY MAP





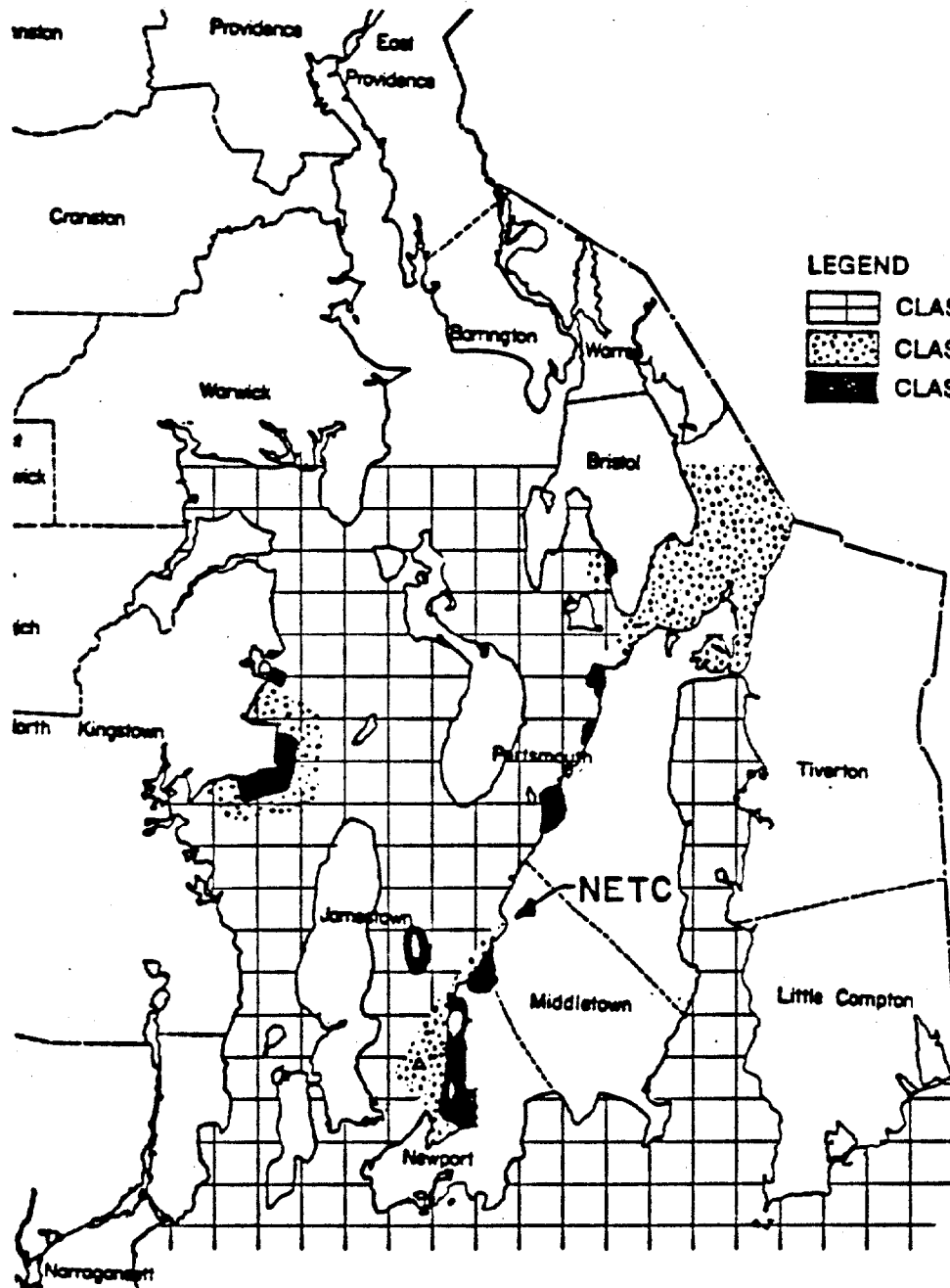
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FIGURE 3.
NARRAGANSETT BAY AREA



LEGEND

-  CLASS SA
-  CLASS SB
-  CLASS SC

0 2 1/2 5
SCALE IN MILES

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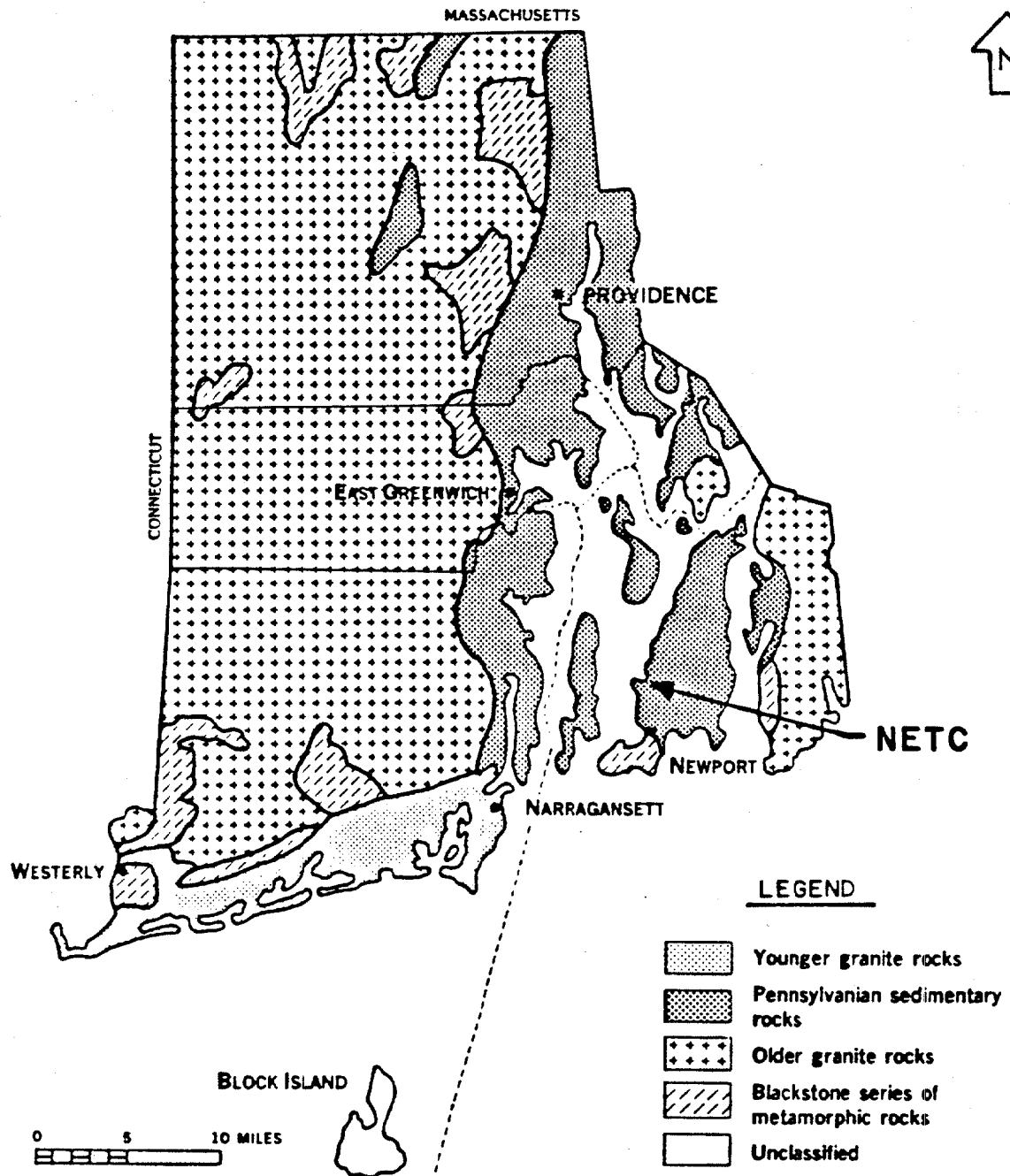
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FIGURE 4.

WATER QUALITY MAP OF
NARRAGANSETT BAY

SOURCE: INITIAL ASSESSMENT STUDY
(ENVIRODYNE, 1983)



SOURCE: INITIAL ASSESSMENT STUDY
(ENVIRODYNE, 1983)

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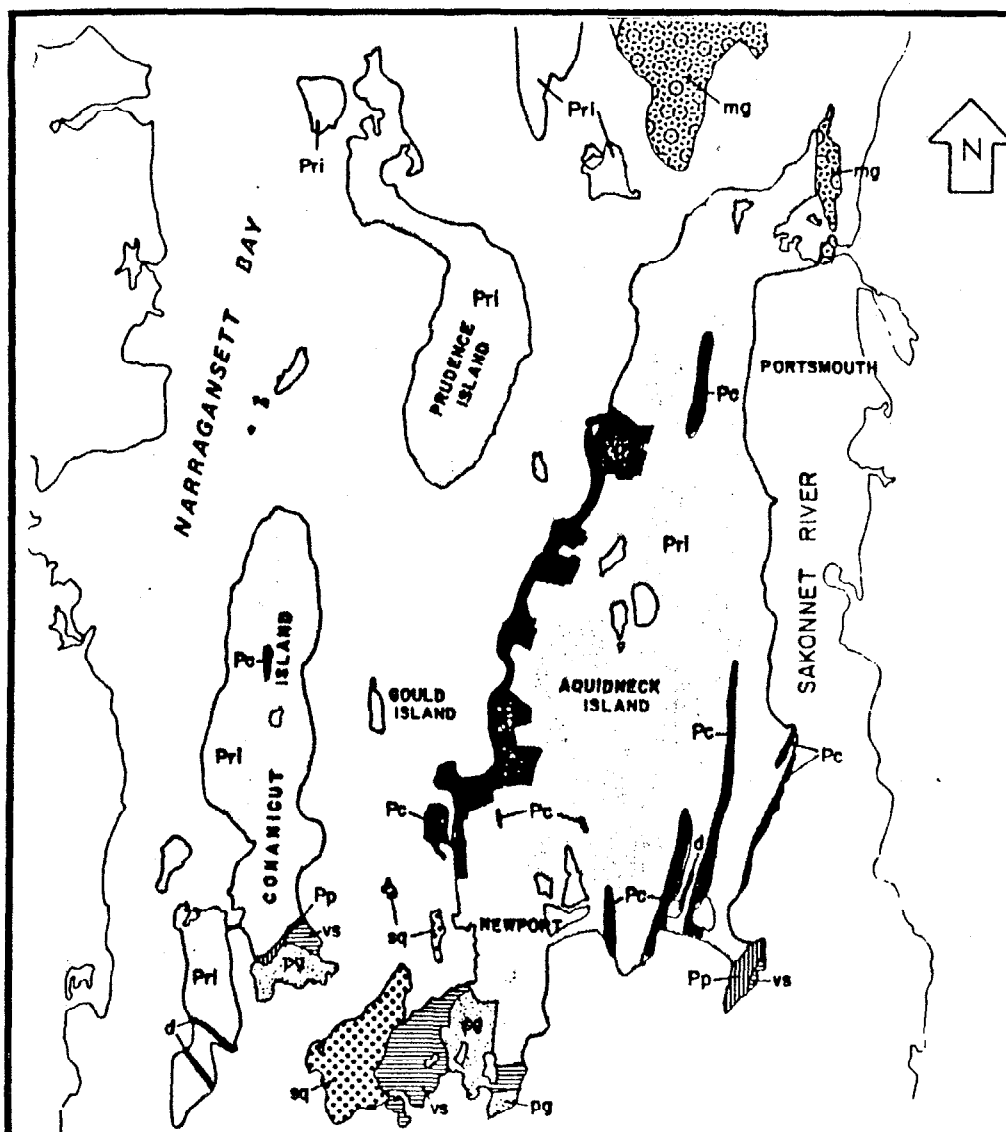
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FIGURE 5.

GENERAL GEOLOGIC MAP OF
RHODE ISLAND



Mafic dikes and sills

- d - Dark-gray to black, fine-grained dikes and sills, in widely different parts of Rhode Island. Several are diabase and olivine diabase; a few are lamprophyres; some are altered and may be pre-Pennsylvanian; most are a foot or a few feet thick and are exposed for only a few feet.

Rhode Island Formation

- Pri - Gray to dark-gray, fine- to coarse-grained sandstone and lithic graywacke, and dark-gray to black shale; also includes conglomerate and meta-anthracite; crossbedding and irregular discontinuous bedding characteristic; plant fossils abundant in a few places; in southwest includes quartz-mica schist, feldspathic quartzite, garnet-staurolite schist, and quartz-mica-sillimanite schist.
- Pc - Gray coarse conglomerate, with pebbles, cobbles, and boulders chiefly of quartzite, interbedded with gray coarse-grained, crossbedded sandstone and lithic graywacke; pebbles and boulders much elongated in southeastern Rhode Island.

Pondville Conglomerate

- Pp - Light-gray to gray or greenish, coarse- to fine-grained conglomerate, with irregularly interbedded sandstone and lithic graywacke; gray granule conglomerate in southeast; present discontinuously at margins of Narragansett basin.

Porphyritic Granite at Newport and Conanicut Island

- pg - Grayish-pink to grayish-green, coarse-grained porphyritic granite, large phenocrysts of microcline and microperthite; main constituents are microperthite, microcline, albite, quartz, hornblende, biotite, chlorite, and epidote.

Metacom Granite Gneiss

- mg - Gray to pink, medium-grained granite gneiss, locally porphyritic; lined with streaks of biotite, locally foliated, consists chiefly of microcline and microperthite, albite, quartz, biotite, and muscovite; small aplite dikes and quartz veins common.

Volcanic Tuff, Conglomerate and Quartzite of Newport Vicinity

- vs - Mostly dark-gray, dense flinty to fine-grained, felsic metavolcanic rocks that weather light gray to greenish gray; probably contains tuff, lapilli tuff, volcanic sandstone and volcanic siltstone; some more massive beds may be flows. Some conglomerate beds near base, as much as 50 feet thick, contain pebbles of quartzite, quartz, granite and volcanic rocks; a few thin lenses of white to gray marble near base.

Slate and Quartzite of Newport Vicinity

- sq - Greenish-gray, green, gray-green, purplish-red, and reddish-purple alternating thin beds of slate and fine- to coarse-grained quartzite; quartzite commonly has cross bedding and graded bedding. Locally thin beds of conglomerate, light-gray quartzite, and lenses of fine-grained marble.

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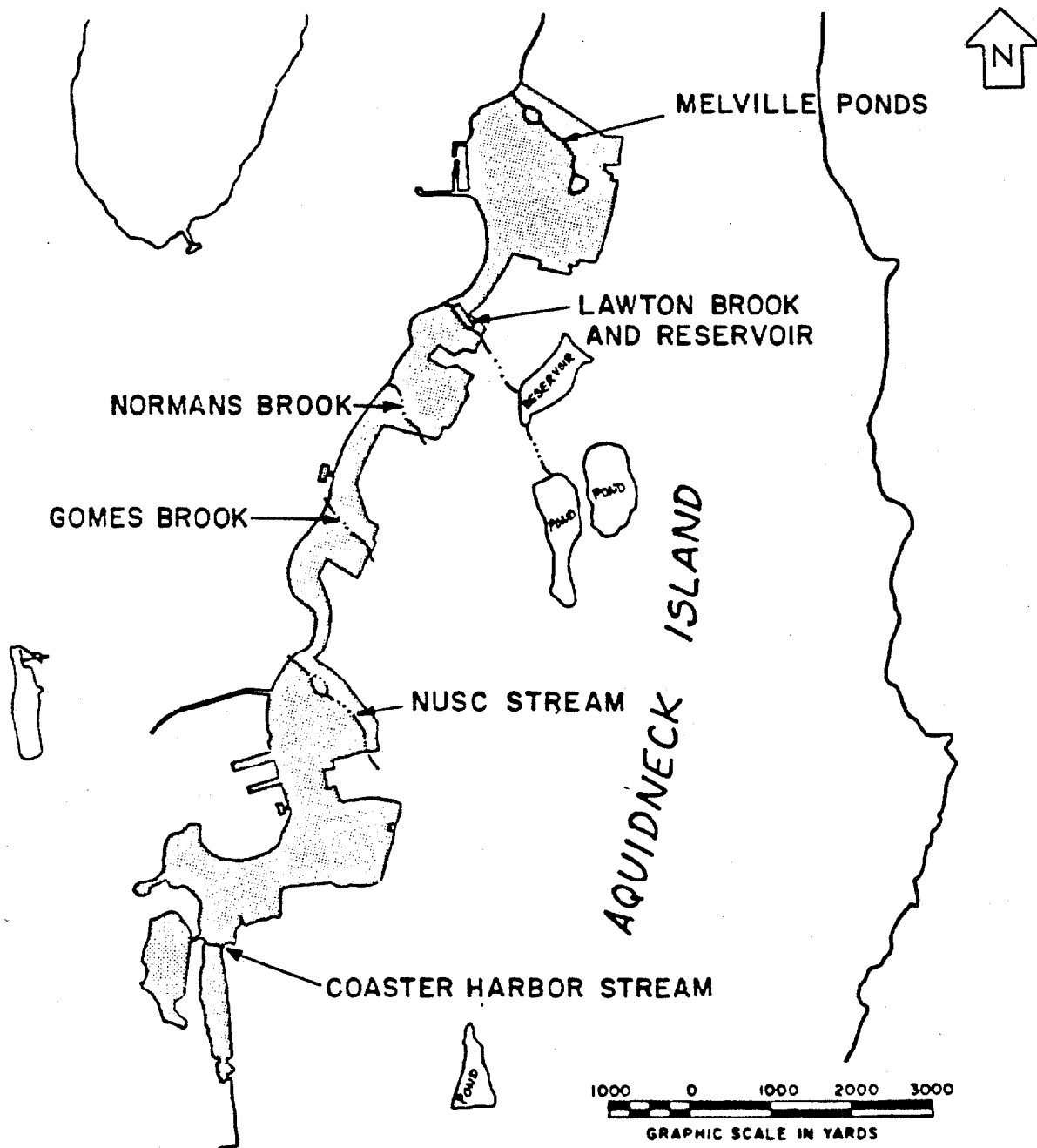
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FIGURE 6.
BEDROCK GEOLOGY MAP OF
NETC AREA

SOURCE: INITIAL ASSESSMENT STUDY
(ENVIRODYNE, 1983)



SOURCE: INITIAL ASSESSMENT STUDY
(ENVIRODYNE, 1983)

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FIGURE 7.

NETC SURFACE DRAINAGE MAP



APPROXIMATE
SITE BOUNDARY

NARRAGANSETT
BAY

PENN CENTRAL RR

DEFENSE HIGHWAY

FENCE X

GATE

DIRT ROAD

0 300 FT
SCALE

TRC

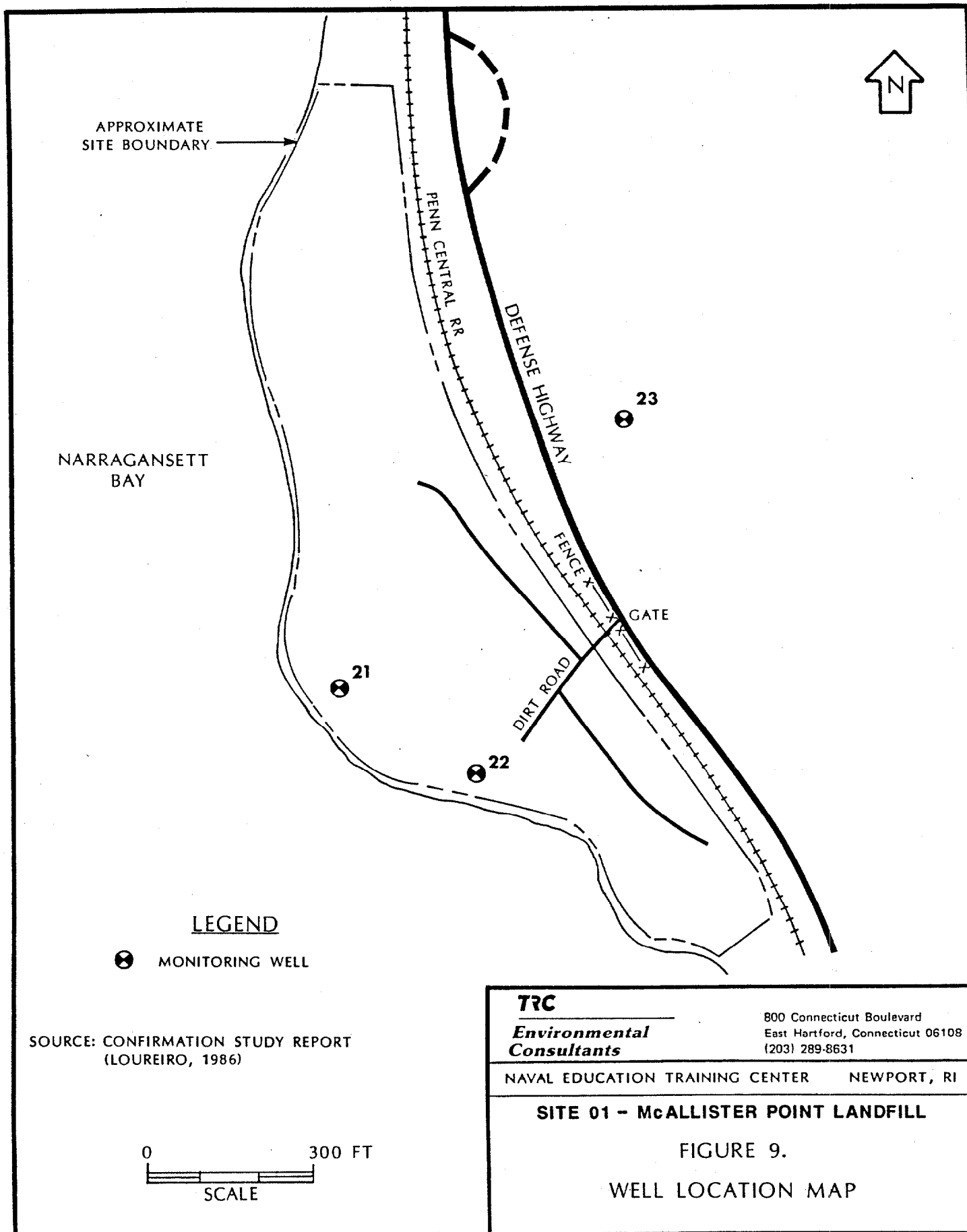
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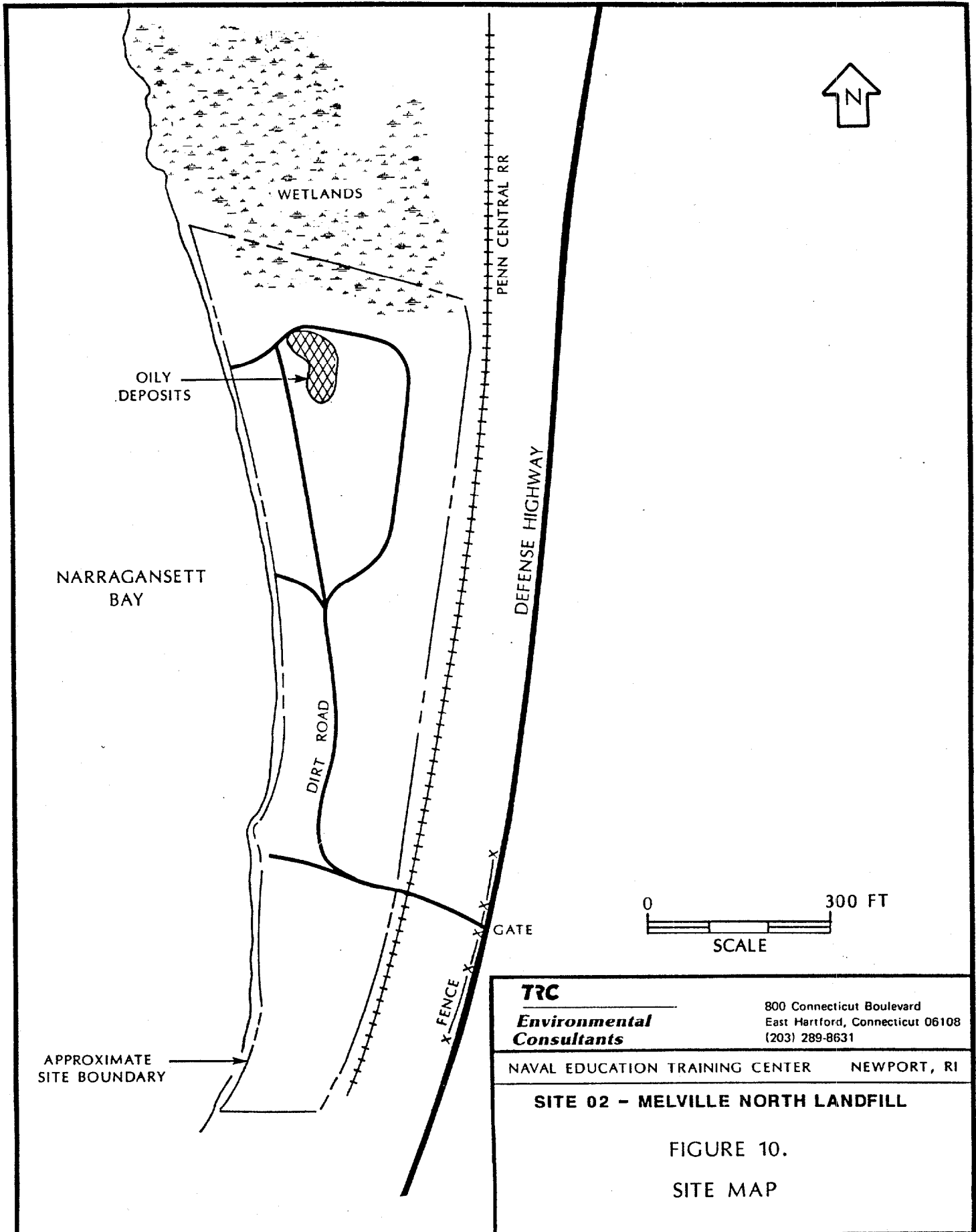
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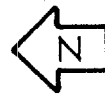
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SITE 01 - McALLISTER POINT LANDFILL

FIGURE 8.
SITE MAP

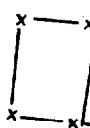
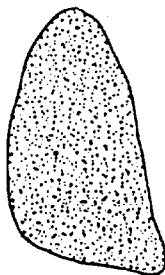






COASTERS
HARBOR

APPROXIMATE
SITE BOUNDARY



CHILD CARE
CENTER

LEGEND



SOIL MOUND



PARKING AREA

x — x FENCE



PAVILLION

TAYLOR DRIVE

BASEBALL
FIELD



NARRAGANSETT
BAY

TRC

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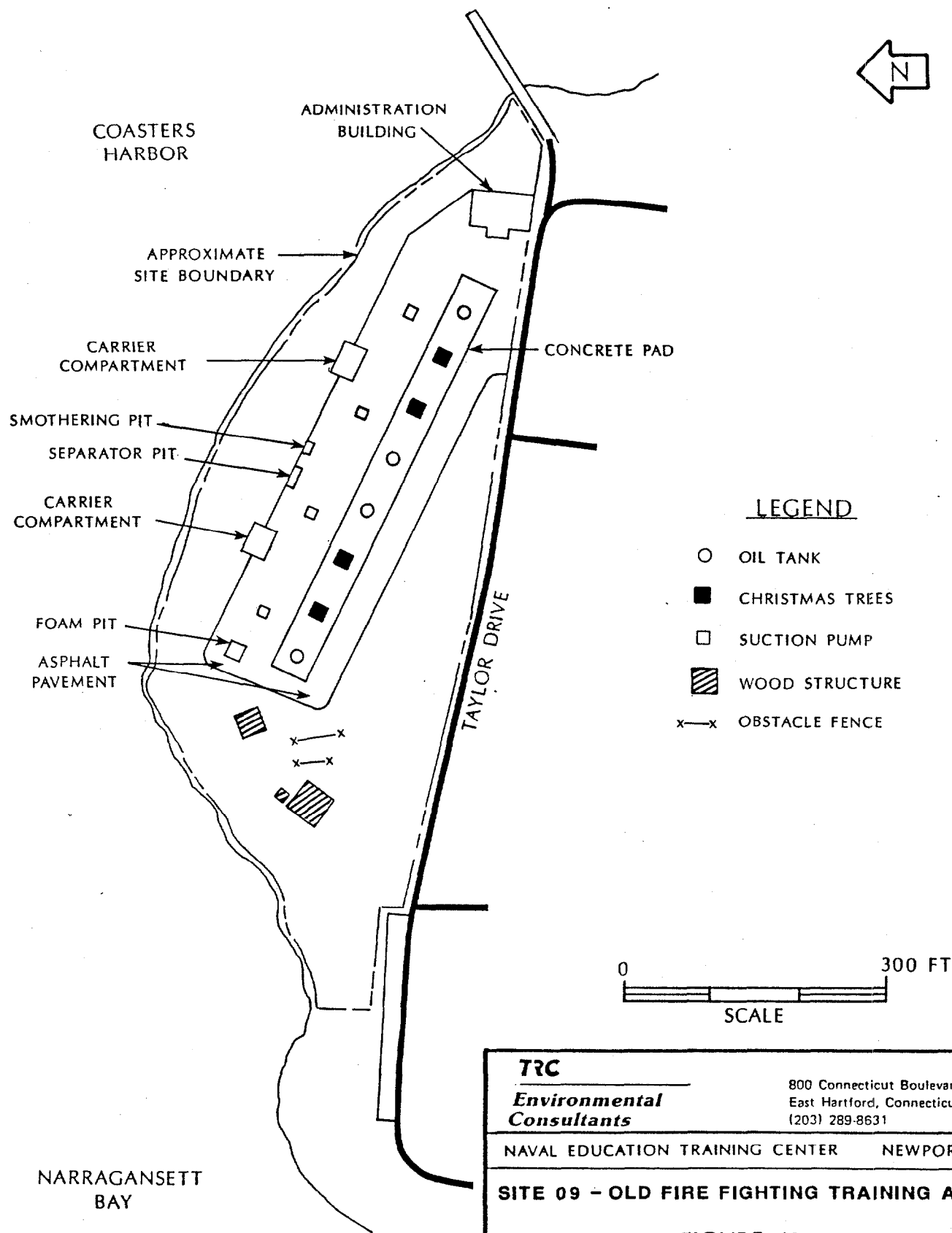
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SITE 09 - OLD FIRE FIGHTING TRAINING AREA

FIGURE 11.

SITE MAP



SOURCE: FIRE FIGHTERS SCHOOL LOCATION
PLAN MAP, PUBLIC WORKS DRAWING
NO. 7146-78 (U.S. NAVY, 1943)

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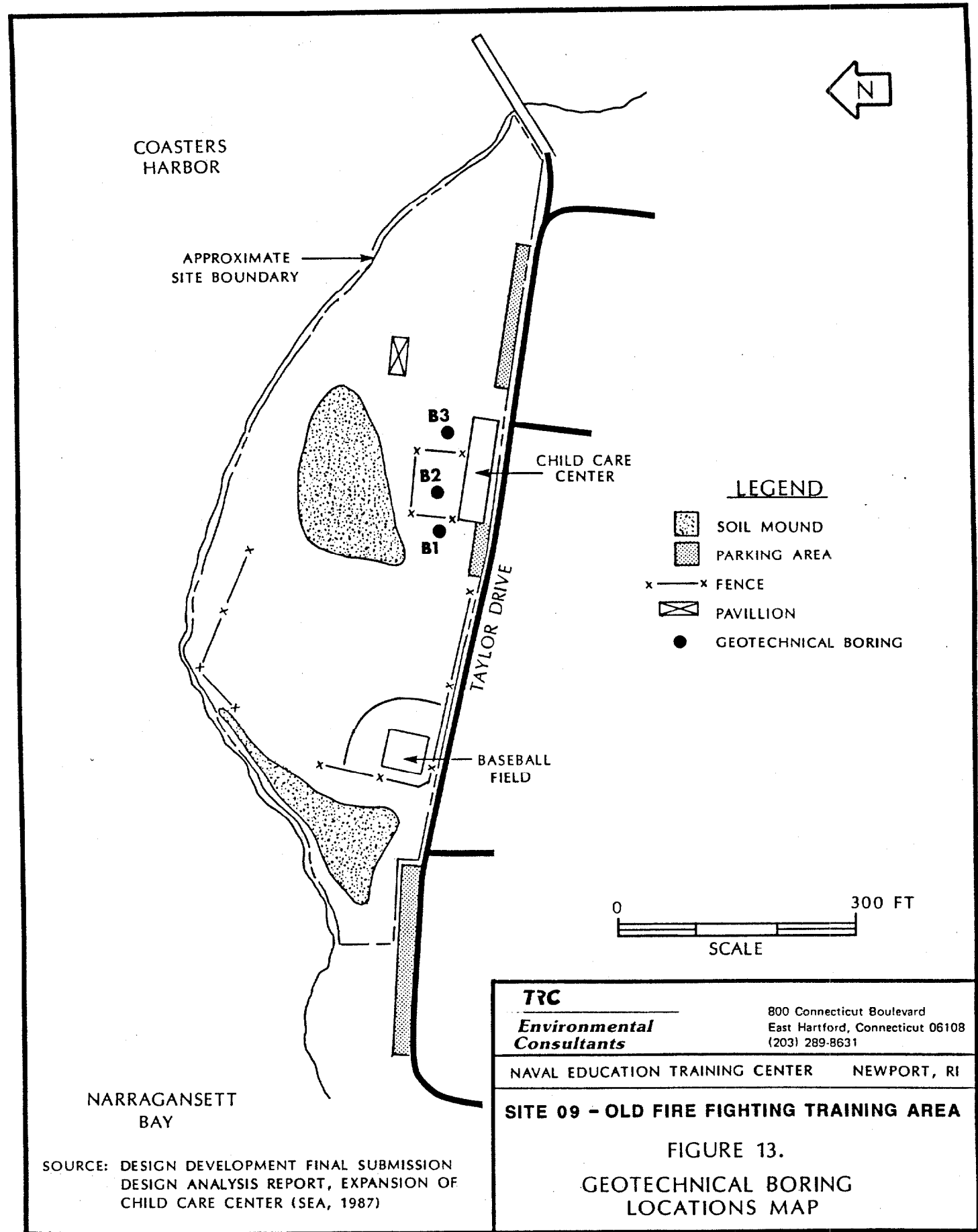
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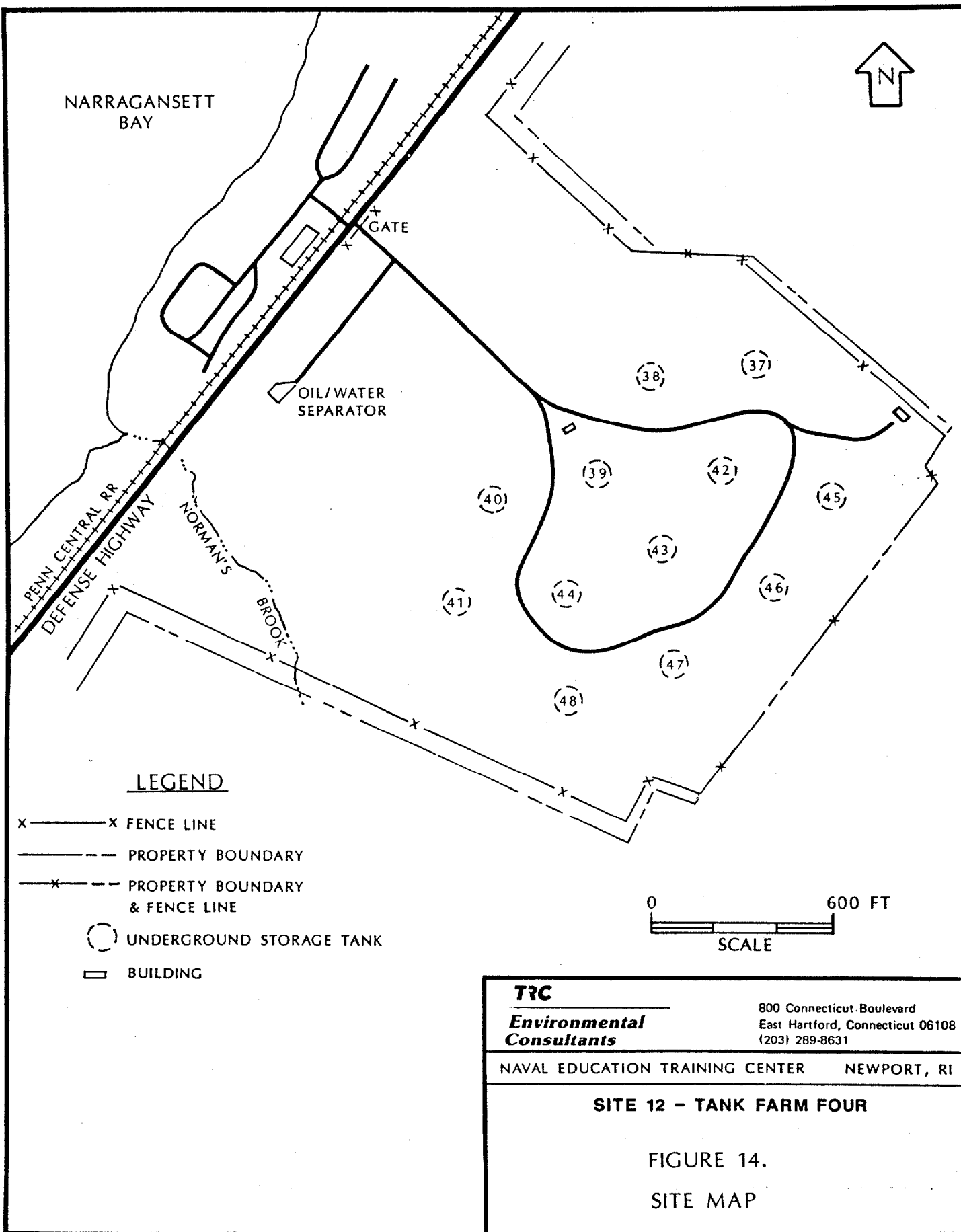
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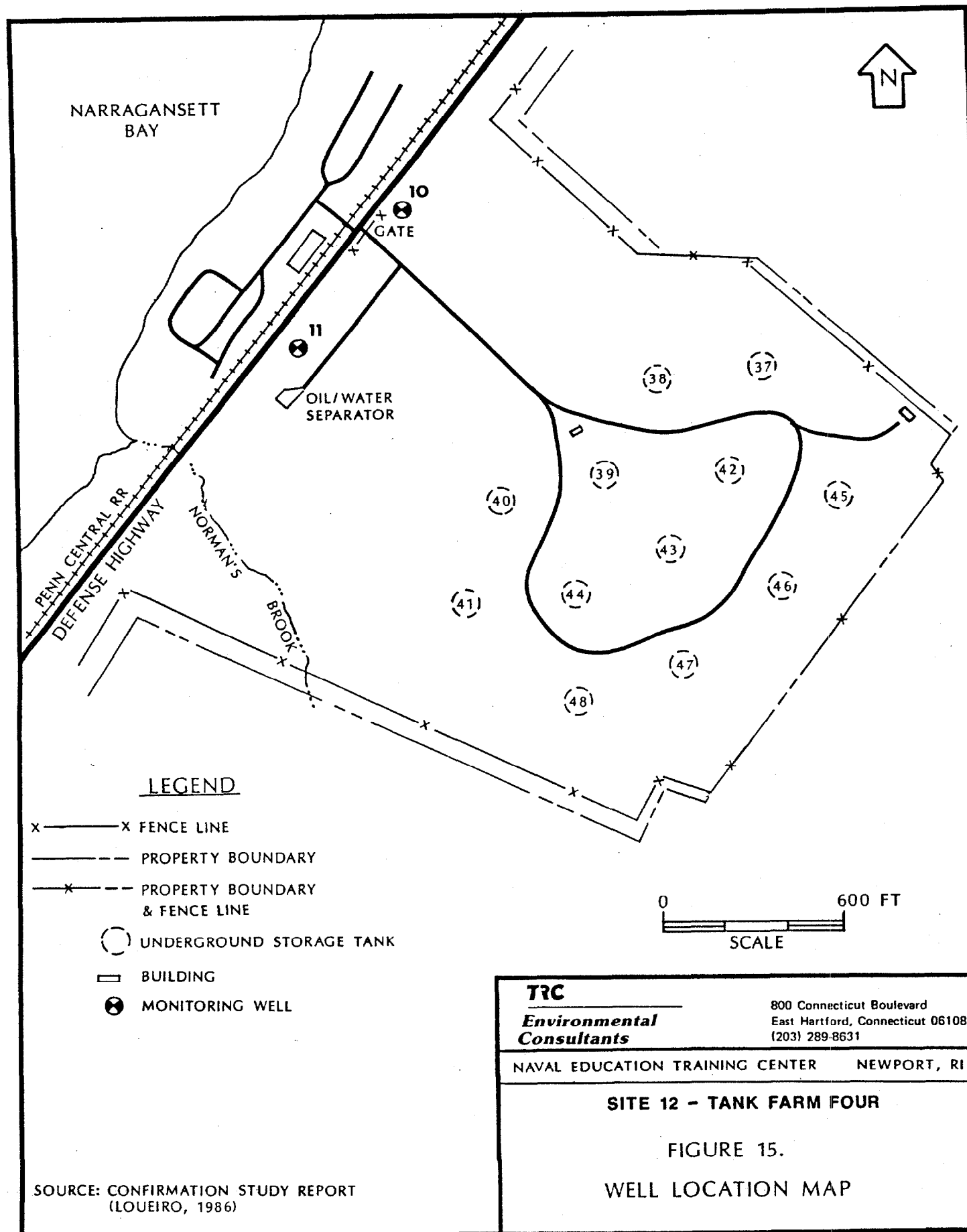
SITE 09 - OLD FIRE FIGHTING TRAINING AREA

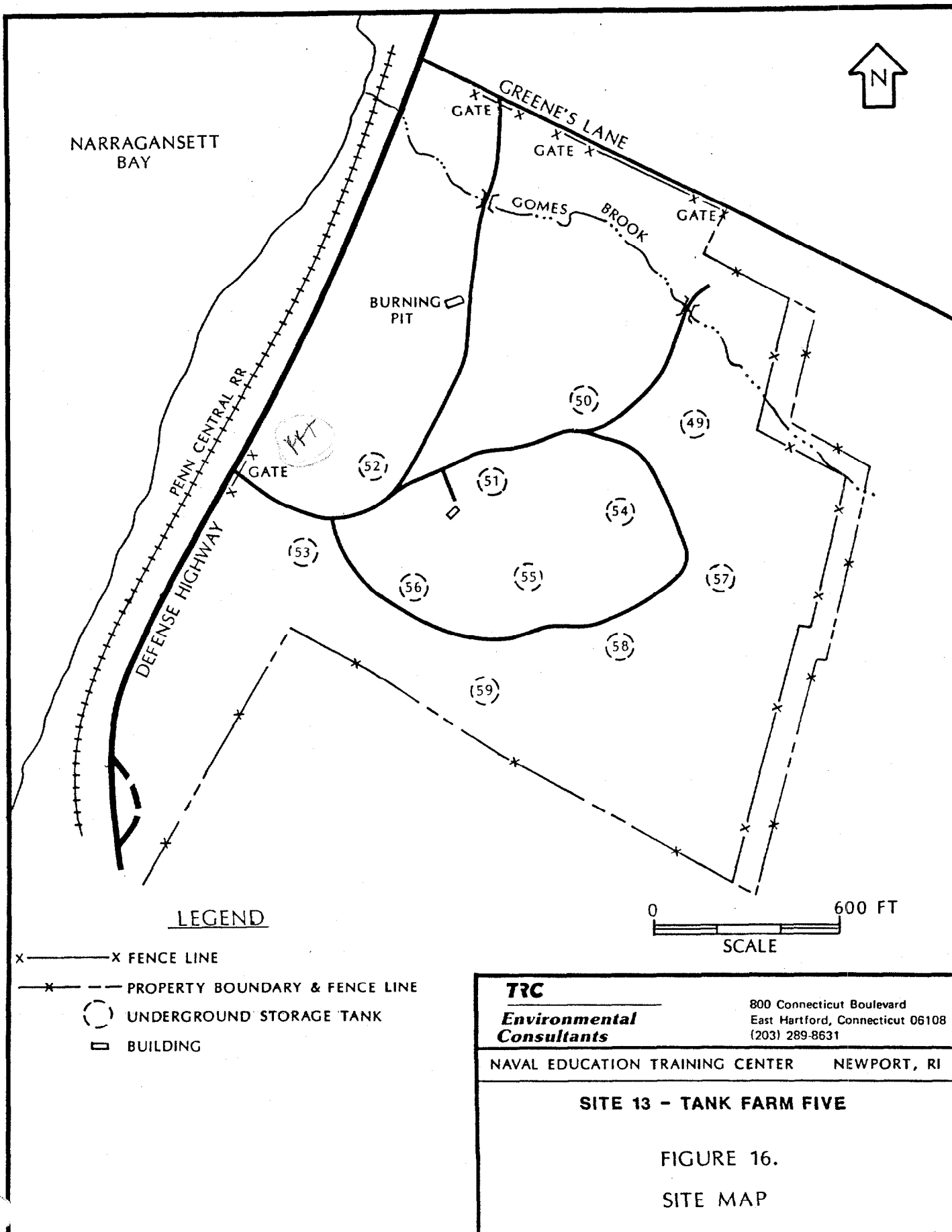
FIGURE 12.

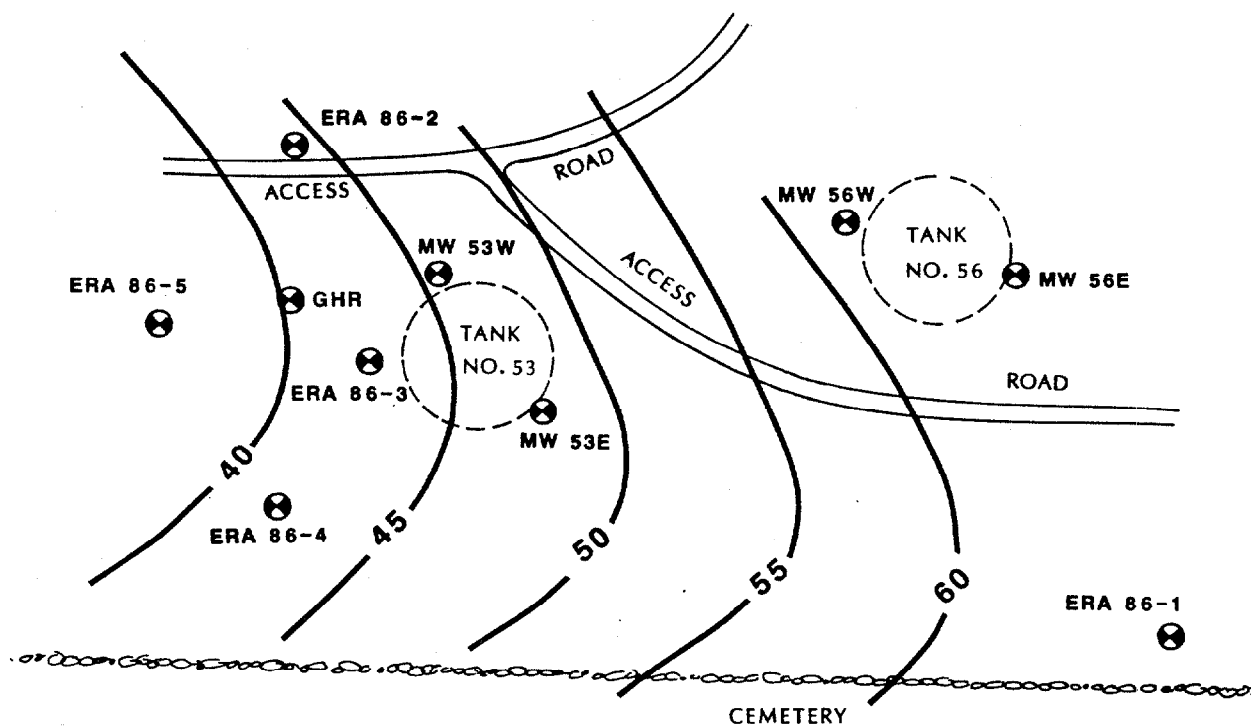
1943 SITE DETAILS MAP











LEGEND

- ⊗ MONITORING WELL
— 45 — GROUND WATER CONTOUR

SOURCE: TANK CLOSURE PLAN
(ERA, 1987)

TRC

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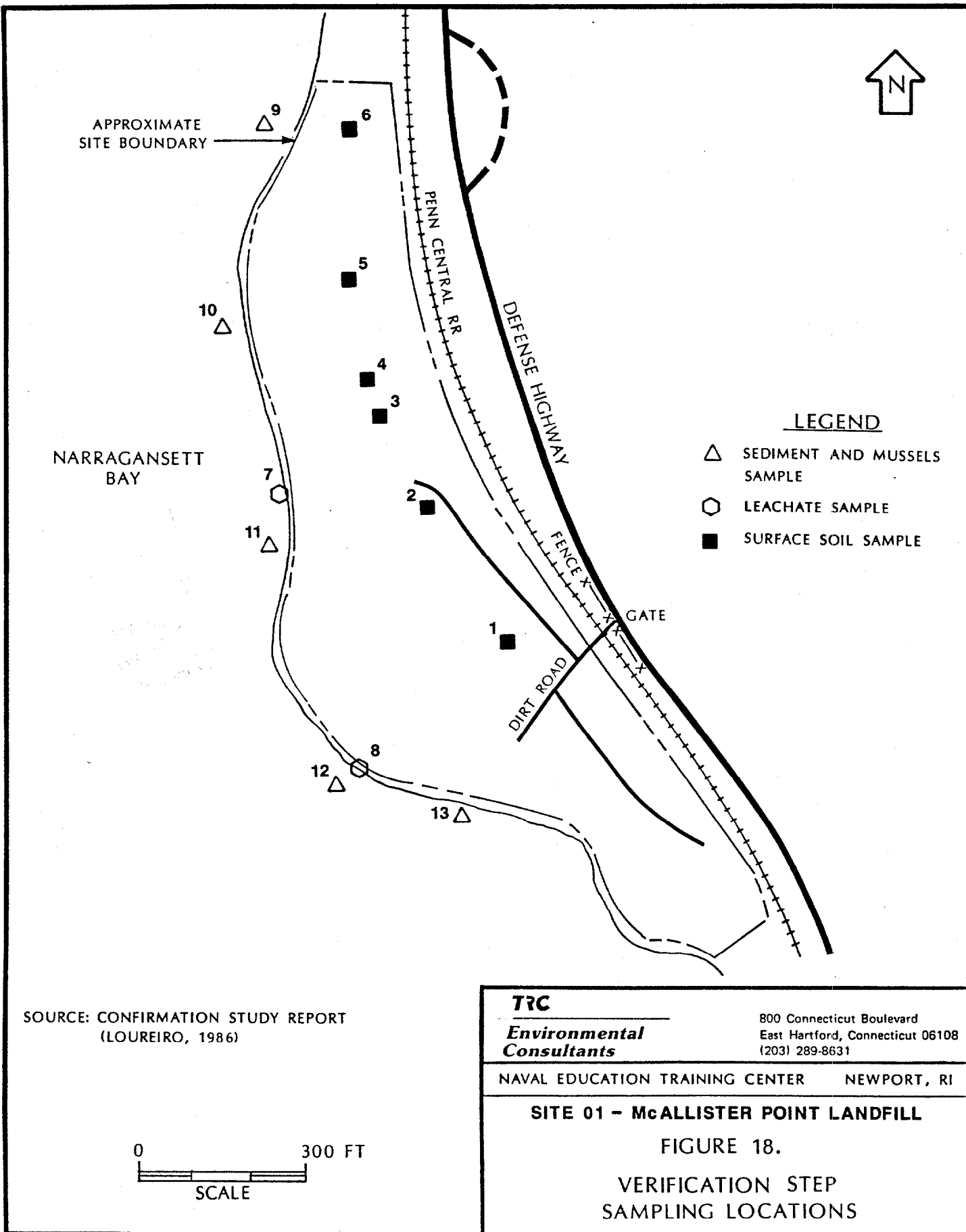
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SITE 13 - TANK FARM FIVE

FIGURE 17.

TANK CLOSURE INVESTIGATION -
GROUND WATER CONTOUR MAP





APPROXIMATE
SITE BOUNDARY

NARRAGANSETT
BAY

PENN CENTRAL RR

DEFENSE HIGHWAY

23

LEGEND

- △ SEDIMENT AND MUSSELS
SAMPLE
- ▲ SEDIMENT SAMPLE
- ◆ MUSSELS SAMPLE
- ⊗ MONITORING WELL

GATE

DIRT ROAD

21

22

15

18

12

16

13

14

20

17

19

SOURCE: CONFIRMATION STUDY REPORT
(LOUREIRO, 1986)

0 300 FT
SCALE

TRC

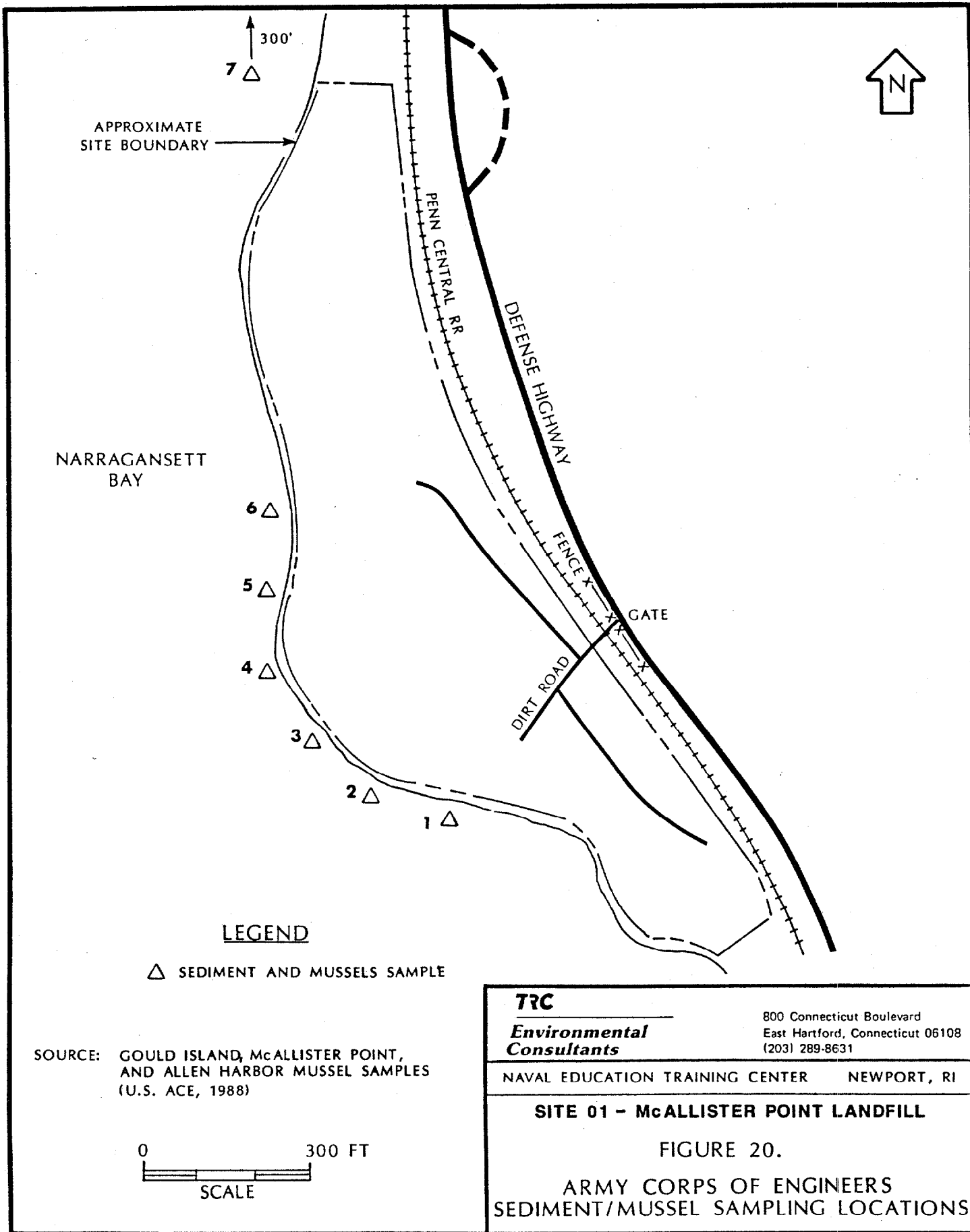
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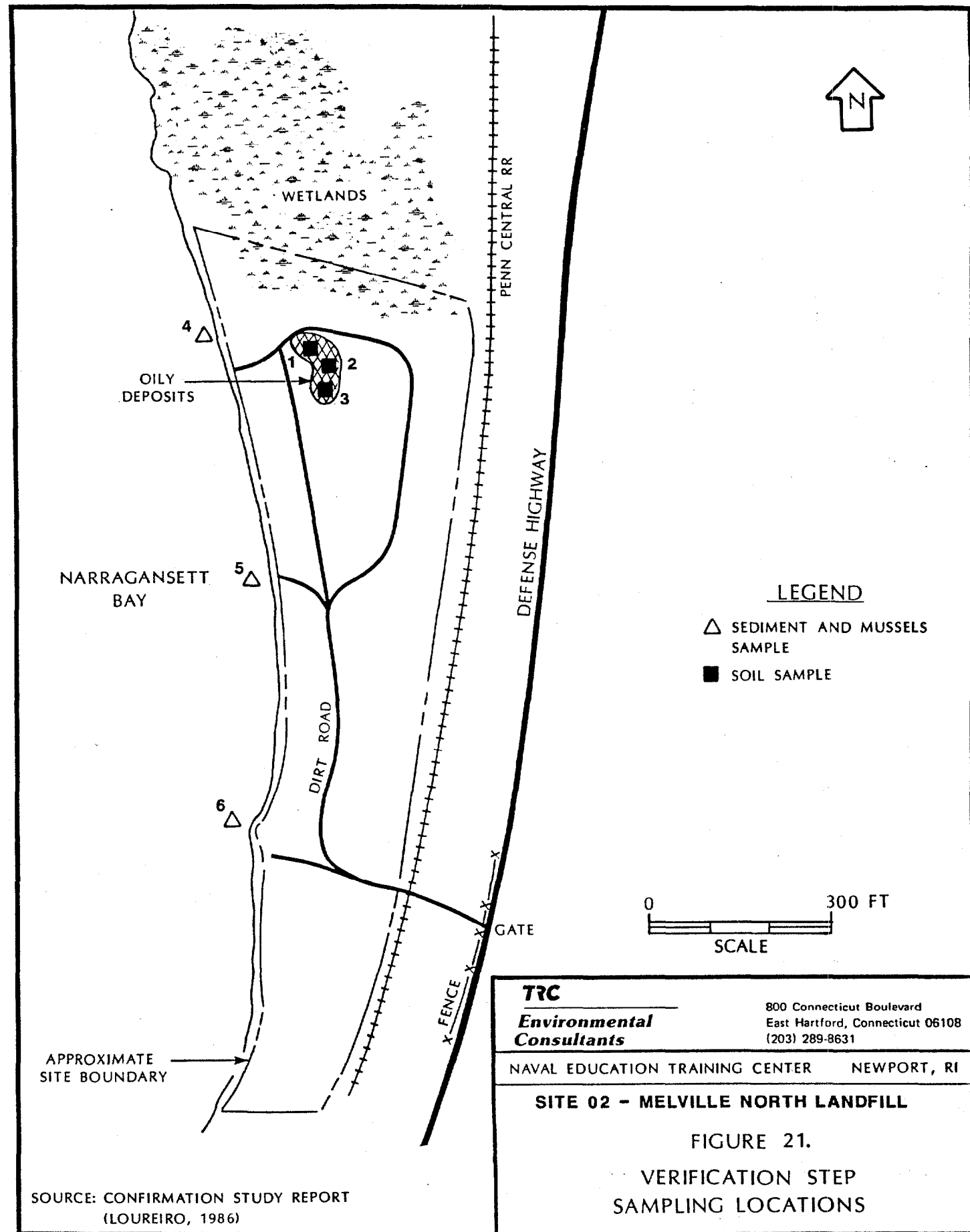
800 Connecticut Boulevard
East Hartford, Connecticut 06108
(203) 289-8631

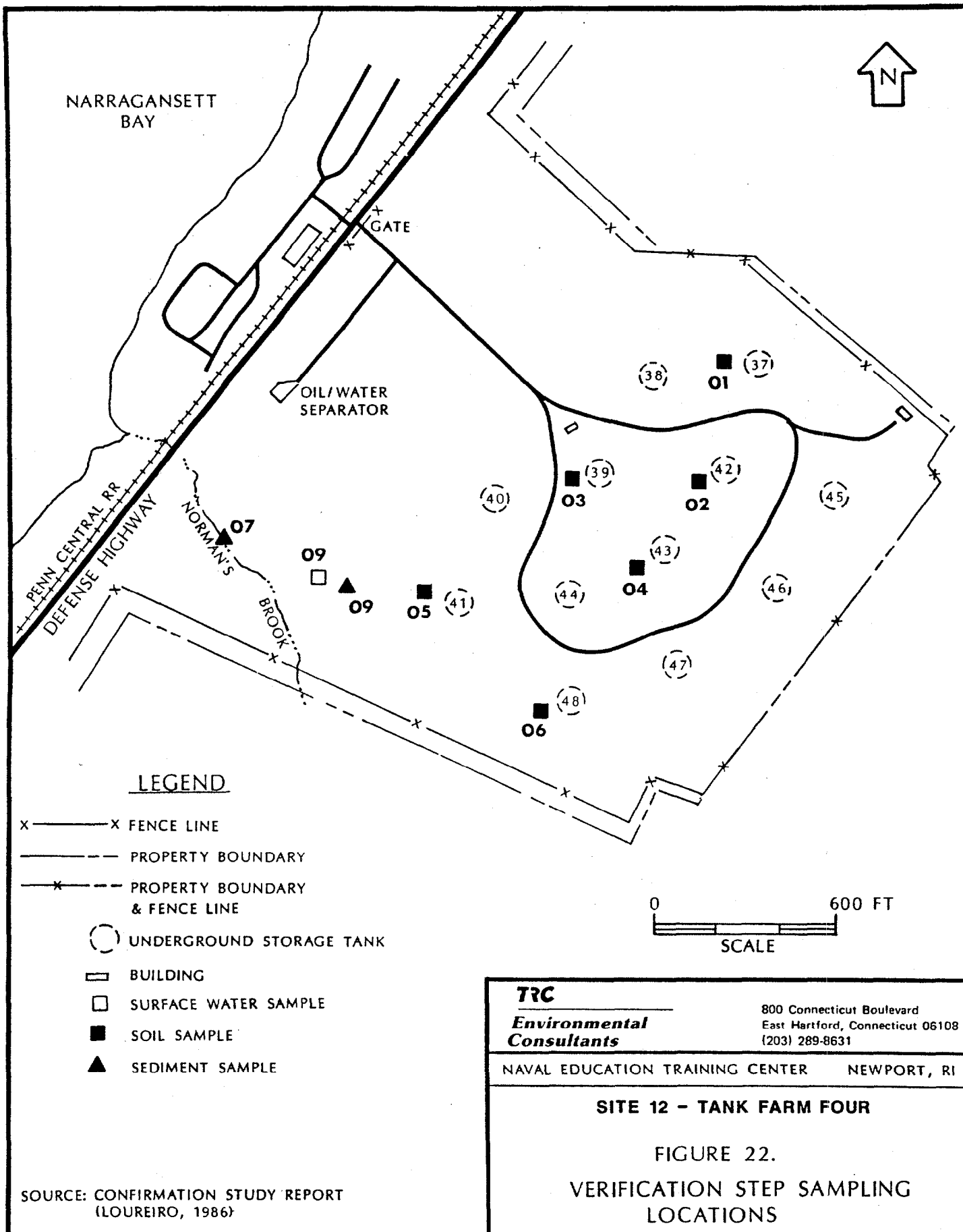
NAVAL EDUCATION TRAINING CENTER NEWPORT, RI

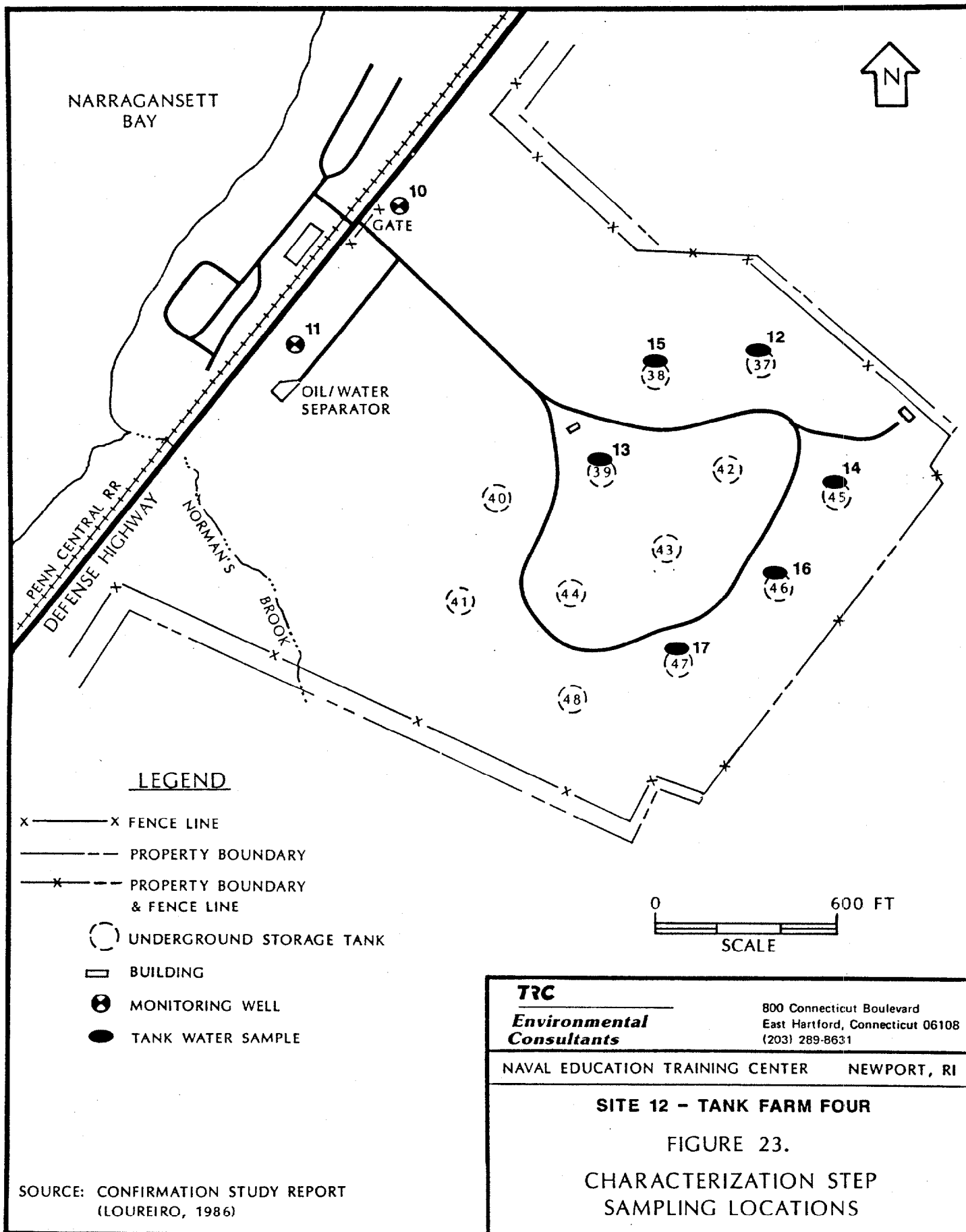
SITE 01 - McALLISTER POINT LANDFILL

FIGURE 19.
CHARACTERIZATION STEP
SAMPLING LOCATIONS









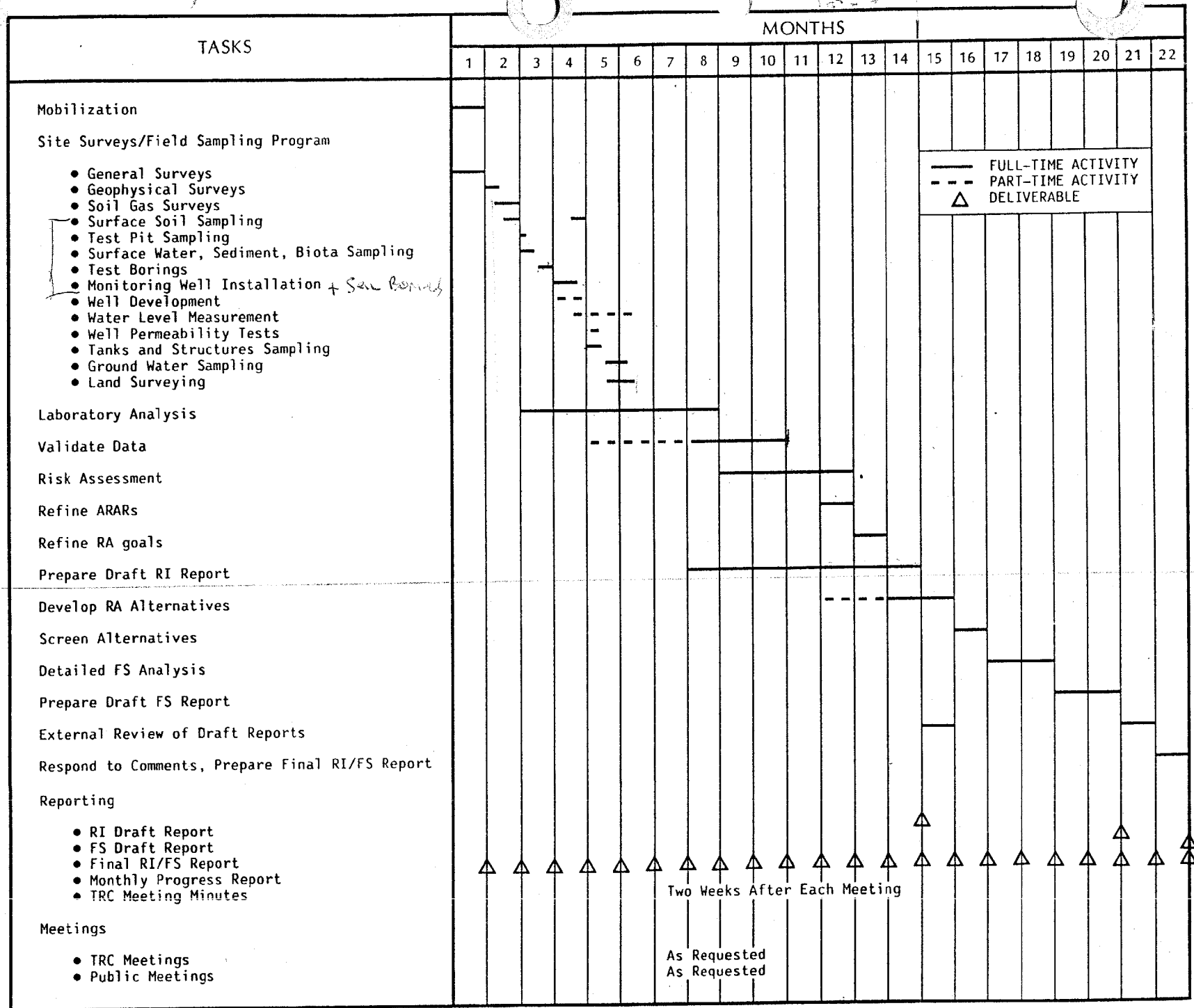


FIGURE 37. ANTICIPATED SCHEDULE FOR NETC-NEWPORT RI/FS

TABLE 1
NETC-NEWPORT
SUMMARY OF FIELD INVESTIGATION PROGRAM

SITE	ACTIVITY	SCOPE	NUMBER OF SAMPLES	SAMPLE ANALYSES
01 - McAllister Point Landfill	Geophysical Survey	50' spaced traverse	N/A	N/A
	Surface Soil Sampling	17 locations	17 samples	TCL plus archive dioxin ⁽¹⁾
	Test Borings	10 borings	2-3 samples/boring	TCL, archive dioxin ⁽¹⁾ , TCLP(4)
	Monitoring Wells	9 wells	1 per well plus 3 existing wells	TCL
	Surface Water Sampling	2 leachate springs	1 per spring	TCL
	Sediment Sampling	20 locations	2 per location	TCL volatiles, semi-volatile, inorganics, PCBs
	Biota Sampling	20 locations	1 per location	TCL semi-volatile, inorganics, PCBs
02 - Melville North Landfill	Geophysical Survey	50' spaced traverse	N/A	N/A
	Surface Soil Sampling	15 locations	15 samples	TCL plus archive dioxin ⁽¹⁾
	Test Pits	Field-determined	2 soil and 2 sludge	TCL, archive dioxin ⁽¹⁾ , TCLP
	Test Borings	10 borings	2-3 samples/boring	TCL, archive dioxin ⁽¹⁾ , TCLP(4)
	Monitoring Wells	5 wells	1 water sample per well; 2-3 soil samples/boring	TCL; TCL, archive dioxin ⁽¹⁾ , TCLP(4)
	Sediment Sampling	10 locations (3 on-site)	1 per location	TCL volatiles, semi-volatiles, inorganics, PCBs
	Biota Sampling	7 locations	1 per location	TCL semi-volatile, inorganics, PCBs
09 - Old Fire Fighting Training Area	Geophysical Survey	50' spaced traverse	N/A	N/A
	Soil Gas Survey	100' site grid	48 points	VOCs
	Surface Soil Sampling	6 locations	6 samples	TCL plus archive dioxin ⁽¹⁾
	Test Borings	7 borings	1-2 samples/boring	TCL, archive dioxin ⁽¹⁾ , TPH ⁽⁵⁾
	Monitoring Wells	5 Wells	1 water sample per well 1-2 soil samples/boring	TCL TCL, archive dioxin ⁽¹⁾ , TPH ⁽⁵⁾
	Sediment Sampling	8 locations	1 per location	TCL volatiles, semi-volatiles, inorganics, PCBs
	Biota Sampling	8 locations	1 per location	TCL semi-volatiles, inorganics, PCBs

BIOTA 20 + 7 + 8 + 0 + 0 = 35
 SURFACE SOILS 17 + 15 + 6 + 30 + 30 = 98
 GROUND WATER 12 + 5 + 5 + 8 + 16 = 46
 TEST BORINGS 20 + 30 + 7 + 8 + 6 = 71
 SURF WATER 2 + 0 + 0 + 3 + 5 = 28
 SEDIMENT 13 + 12 = 25

TEST PITS 4
 TANKS/STR. 13 + 12 = 25

TOTAL
 382

TABLE 1
NETC-NEWPORT
SUMMARY OF FIELD INVESTIGATION PROGRAM
(Continued)

SITE	ACTIVITY	SCOPE	NUMBER OF SAMPLES	SAMPLE ANALYSES
12 - Tank Farm Four	Soil Gas Survey	400' site grid and 4 per tank area	Approx. 80 points	VOCs
	Surface Soil Sampling	1-2 per tank area/ 1 per tank area ⁽²⁾	30/18 ⁽²⁾ samples	TPH, lead/TCL pesticides, PCB ⁽²⁾ ⁽³⁾
	Monitoring Wells	8 wells	1 water sample per well; 1-2 soil samples/boring	TCL; TCL, archive dioxin ⁽¹⁾ , TPH ⁽⁵⁾
	Surface Water Sampling	3 locations	1 per location	TCL (less pesticides/PCBs)
	Sediment Sampling	6 locations	2 per location	TCL (less pesticides)
	Tank and Structure Sampling	12 tanks and 1 structure	1-3 per location	EP Toxicity, (less pesticides) ⁽¹⁾ TCL volatile, semi-volatile, inorganics ⁽⁷⁾ TCL (less pesticides/PCBs) ⁽⁸⁾ TCL (less pesticides), archive dioxin ⁽¹⁾ ⁽⁹⁾
13 - Tank Farm Five	Soil Gas Survey	400' site grid and 4 per tank area	Approx. 65 points	VOCs
	Surface Soil Sampling	1-2 per tank area/ 1 per tank area ⁽²⁾	30/18 ⁽²⁾ samples	TPH, lead/TCL pesticides, PCB ⁽²⁾ ⁽³⁾
	Monitoring Wells	6 wells	1 water sample per well and 2 existing wells; 8 existing wells;	TCL; TPH, lead
	Surface Water Sampling	5 locations	1-2 soil samples/boring	TCL, archive dioxin ⁽¹⁾ , TPH ⁽⁵⁾
	Sediment Sampling	5 locations	1 per location	TPH, Lead
	Tank and Structure Sampling	11 tanks and 1 structure	1 per location 1-3 per location	TPH, Lead PCBs EP Toxicity, TCL (less pesticides) ⁽⁷⁾ TCL volatile, semi-volatile, inorganics ⁽⁷⁾ TCL (less pesticides/PCBs) ⁽⁸⁾ TCL (less pesticides), archive dioxin ⁽¹⁾ ⁽⁹⁾

NOTES:

- (1) Samples archived for dioxin and furan analyses.
- (2) Phased investigation, first phase/second phase.
- (3) One sample analyzed for pesticides/PCBs.
- (4) TCLP analysis of approximately 50% of fill samples.
- (5) TPH analysis if no contamination observed in boring.
- (6) Sludge fraction analyses.
- (7) Water fraction analyses.
- (8) Oil fraction analyses.
- (9) Structure soil/waste samples.

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

RI/FS WORK PLAN
FOR THE
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared for:

Northern Division - Naval Facilities
Engineering Command
Philadelphia, PA

VOLUME II
FIELD SAMPLING PLAN

March 1989

TRC Project No. 5383-N81-40
Contract No. N62472-86-C-1282

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A

SAMPLING METHODS

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1.0 INTRODUCTION

This Field Sampling Plan describes in detail the field tasks necessary to conduct the remedial investigation of five sites at the Naval Education and Training Center (NETC) in Newport, Rhode Island. Field investigation activity details are presented for the following five NETC sites: McAllister Point Landfill (# 01), Melville North Landfill (# 02), Old Fire Fighting Training Area (# 09), Tank Farm Four (# 12), and Tank Farm Five (# 13). A map of each site is provided on Figures 1 through 5. Information which was used in developing this sampling plan included previous site investigation results of an Initial Assessment Study (Envirodyne, 1983) of all of the sites and a follow-up Confirmation Study (Loureiro, 1986) of three of the five sites listed above (McAllister Point Landfill, Melville North Landfill, and Tank Farm Four). Information obtained from a tank closure report (ERA, 1987) for two tanks at Tank Farm Five was also used in developing the sampling plan for that site. A summary of the results of those studies is presented in the Background Investigation Report provided as Volume I of this Work Plan. This sampling plan addresses the recommendations of the Confirmation Study completed for three of the sites. The plan also addresses those data requirements necessary for conducting a remedial investigation and feasibility study under CERCLA, as amended by SARA, and the NCP. The general procedures for meeting those data requirements were adopted from the current EPA RI/FS guidance (U.S. EPA, 1988). Some of the field sampling methods to be used during the RI and referenced in this plan were adopted from other EPA guidance documents (U.S. EPA, 1984 and U.S. EPA 1987).

This sampling plan is organized by the type of activity and matrix sampled, rather than by site. For example, all of the sites planned for soil gas surveys are discussed together, along with the sampling methodology. The field activities are presented in the plan according to the chronological order in which they are planned to occur, starting with the field mobilization and ending with a land survey of all the sample locations. As is presented in the EPA RI/FS guidance, the elements addressed in this sampling plan include the following:

- sampling objectives;
- sample location and frequency;
- sample analyses;

- sample equipment and procedures; and
- sample designation.

A preliminary risk assessment was performed for several of the sites in the Confirmation Study (Loureiro, 1986). The results of this and other studies at the sites indicated that additional field investigation activities are necessary to determine whether, and to what extent, a threat to human health or the environment exists.

The focus of this sampling plan is to ensure that adequate data is available to perform risk/endangerment assessments consistent with current EPA guidance. The proposed sampling plan also meets current Navy policy to follow CERCLA guidance and procedures while conducting investigations at hazardous waste sites. This sampling plan presents the minimum investigation effort believed necessary to evaluate the contamination at each site. The sampling effort will be expanded as is indicated necessary by the findings and sample results of the initial investigation activities.

The field survey and sampling procedures for each activity are described in the Sections 3.0 and 4.0 of this plan. A summary of the planned field investigation activities is presented in Table 3 at the end of Section 4.0. When applicable, EPA guidance documents are referenced concerning appropriate survey and sampling methods. Copies of the referenced survey and sampling methods are provided in Appendix A of this plan.

The quality assurance/quality control procedures for field sampling and laboratory analyses are presented in the project Quality Assurance/Quality Control (QA/QC) Plan provided in Volume III of this Work Plan. All of the laboratory analytical procedures will be conducted according to established EPA Contract Laboratory Program (CLP) protocols; however, the data packages and validation procedures will adhere to Naval Energy and Environmental Support Activity (NEESA) Level C protocols.

The mandatory health and safety guidelines for all of the field investigations are presented in the Health and Safety Plan (HASP) provided in Volume V of this Work Plan. The HASP is based on established TRC Corporate Health and Safety Program which was developed in accordance with all applicable federal requirements.

1.1 Sampling Plan Objectives

The proposed sampling effort for each site was developed based upon the need to obtain additional field data in order to meet site-specific RI/FS objectives. As specified by EPA RI/FS guidance, in general, the RI/FS must obtain data to define the sources of contamination, determine the nature and extent of contamination, potential migration pathways, and the potential receptors and associated exposure pathways to the extent necessary to:

- determine whether, and to what extent, a threat to human health or the environment exists; and
- develop and evaluate remedial action alternatives.

The specific sampling plan objectives for each site are presented below.

Site 01 - McAllister Point Landfill

- determine the presence and nature of surface soil contamination;
- determine the extent of fill material;
- determine the nature of fill material contamination;
- determine the nature and extent of ground water contamination;
- determine the nature and extent of sediment and biota contamination in the adjacent bay; and
- determine the degree of hydraulic connection between the ground water and adjacent bay.

Site 02 - Melville North Landfill

- determine the presence and nature of surface soil contamination;
- determine the nature and extent of contamination related to the oily deposits on a portion of the site;
- determine the location of the waste lagoons which existed on the site;
- determine the nature of contamination in the pre-existing waste lagoons;
- determine the location and extent of fill material;
- determine the nature of fill material contamination;
- determine the presence and nature of ground water contamination;

- determine the degree of hydraulic connection between the ground water and adjacent bay; and
- determine the presence and nature of sediment and biota contamination in the adjacent bay.
- determine the presence and nature of sediment contamination in the wetlands adjacent to the site.

Site 09 - Old Fire Fighting Training Area

- determine the presence and nature of surface soil contamination;
- determine the nature and extent of subsurface soil contamination;
- determine the presence and nature of ground water contamination;
- determine the degree of hydraulic connection between the ground water and adjacent bay; and
- determine the presence and nature of sediment and biota contamination in the adjacent bay.

Site 12 - Tank Farm Four

- determine the locations of past sludge disposal/burning areas;
- determine the nature of contamination associated with the past sludge disposal/burning areas;
- determine the nature and extent of surface water and sediment contamination in the on-site brook;
- determine the nature and extent of ground water contamination;
- determine the physical and waste characteristics of the contents of the underground storage tanks; and
- determine the presence and nature of contamination in the oil/water separator.

Site 13 - Tank Farm Five

- determine the locations of past sludge disposal/burning areas;
- determine the nature of contamination associated with the past sludge disposal/burning areas;
- determine the nature and extent of surface water and sediment contamination in the on-site brook;
- determine the nature and extent of ground water contamination;
- determine the physical and waste characteristics of the contents of the underground storage tanks; and
- determine the presence and nature of contamination in the burning pit.

2.0 MOBILIZATION

The project mobilization activities include establishing a field office, equipment storage area, and equipment decontamination areas. The details of the location and/or construction of these facilities are subject to Navy approval. These facilities and the defined work zones for each site are described in the discussion below.

2.1 Field Office and Storage Facilities

A field office trailer and equipment storage trailer will be established at the McAllister Point Landfill for use during the investigation of all five sites. The field office trailer will serve as the central command center for all field investigation activities. The equipment storage trailer will be located adjacent to the field office trailer. The equipment storage trailer will have two separate rooms which will serve as storage areas for personnel protection equipment and sampling equipment, respectively. Each trailer will have electricity and in addition the office trailer will have telephone service. A portable personnel sanitary facility will be located adjacent to these two trailers for use by on-site personnel during the field investigation activities. The portable sanitary facility will be serviced weekly by the supply vendor. The proposed location for the trailers and portable sanitary facility is provided in the HASP.

The field office trailer will serve as the central work area for all sample documentation activities. Copies of all site reports, investigation plans, maps, sample log books, and chain-of-custody records will be maintained in this trailer. As specified in the project Health and Safety Plan (HASP) (contained as Volume V of this Work Plan), critical emergency situation information (e.g., emergency numbers, hospital location map) will be prominently displayed in the office trailer for quick reference.

The field office will also serve as the central communication base for the coordination of all field activities. Field teams at each site will be equipped with portable 2-way FM radios to allow direct communication between the field teams and command center. Radio communication will broadcast using only those radio frequencies and power levels pre-approved by the Navy. Also,

as previously discussed, the field office trailer will be equipped with telephone service to provide communication with outside parties during all site investigation activities.

2.2 Equipment Decontamination Areas

The decontamination of field equipment is necessary for increased personnel protection and to minimize the possibility of spreading contamination and/or cross contamination during investigation activities. Decontaminated equipment will be used at each sampling station and for each sample collected at a particular station.

During the mobilization activities, an equipment decontamination area will be constructed at three of the five sites planned for investigation. Due to the difficulty in restricting site access and the visibly undisturbed nature of the site, an equipment decontamination area will not be constructed at the Old Fire Fighting Training Area site. All equipment decontamination associated with this site will occur at one of the other established site decontamination areas. Due to the possible variable nature of contamination at each of the two landfills, an equipment decontamination area will be constructed at each of these sites. Given the similarity in the nature of contamination and proximity of Tank Farms Four and Five, an equipment decontamination area will be constructed at Tank Farm Five for use during the investigation of both tank farms. The decontamination area will be constructed at Tank Farm Five since it will provide closer access for the decontamination of equipment from the Old Fire Fighting Area site, which is expected to have contamination similar to the tank farms.

Contaminated downhole drilling/sampling equipment will be transported from the Old Fire Fighting Training Area and Tank Farm Four to the Tank Farm Five decontamination area for cleansing. Prior to transporting the equipment to Tank Farm Five, excess contamination (e.g., drill cuttings) on all sampling equipment will be removed from the vehicles and equipment and used as backfill at the appropriate sample location or contained in an approved 55-gallon drum. The site-specific criteria concerning the planned, final disposition of the test boring drill cuttings is presented in the "Test Boring Sampling Methods" section of this report. All well boring drill cuttings will be

contained in 55-gallon drums. All used equipment (e.g., spoons, augers) will be appropriately contained with plastic sheeting or other suitable methods (e.g., plastic trash bags) to eliminate the potential of spreading contamination while in transit to the off-site, designated decontamination area. The locations for the three designated equipment decontamination areas are provided in the project HASP. A typical cross-section of a decontamination pad is provided on Figure 6.

The field investigation equipment which will be decontaminated at the designated areas includes drill rigs, downhole drilling/sampling equipment (e.g., augers, split spoons), backhoes, and well construction material. Drill rigs (i.e., drilling rods and platform) and backhoes (i.e., bucket and boom) will be decontaminated between each sampling/investigation station. All downhole drilling and sampling equipment will be decontaminated prior to each use and at the completion of all investigation activities. Well construction materials (e.g., casing, screen, fittings) will be decontaminated prior to installation.

A steam cleaner will be used for equipment decontamination at each of the designated equipment decontamination areas. Additional field decontamination procedures will be followed on the downhole sampling equipment (i.e., split spoons) and well construction materials as detailed in the QA/QC Plan provided in Volume III of this Work Plan.

Wash water resulting from the decontamination activities will be collected and stored in Department of Transportation (DOT)-approved 55-gallon drums. Specific drum handling and storage procedures are provided in Section 4.5.3 of the project Health and Safety Plan. All decontamination waters will be segregated and contained in labelled drums according to contributing site and activity to aid in the identification of potentially contaminated water following the field investigation. All drums will be stored in the assigned drum staging area located at each of the three sites having equipment decontamination areas. The locations for the drum staging areas will be selected in consultation with the Navy during the mobilization activities.

2.3 Site Work Zones

Each site will be divided into designated work zones to control and reduce both the possibility of human contact with any contaminants present at a site, and the removal of contaminants by personnel or equipment leaving a site. Overall, site control is necessary to provide safe working conditions for on-site personnel. Each site will be divided into three contiguous zones as indicated in the project HASP provided in Volume V of this Work Plan. The three zones will include a support area, which is an area that will be considered noncontaminated or clean, a contamination reduction or decontamination area, and an exclusion area which is an area that will be considered contaminated. The planned locations for each site's work zones are provided in Section 4.8 of the HASP.

The support zone will contain investigation support equipment (i.e., command post, equipment storage area, vehicles). The field office trailer, which will be located in the support zone for the McAllister Point Landfill site, will be the central command center for all of the site investigations. All of the other site support zones will contain the on-site personnel vehicles which will provide daily storage space and temporary shelter for the personnel.

The contamination reduction zone or decontamination zone will be marked and consist of an area between the exclusion zone and support zone. All personnel and equipment entering or exiting the exclusion zone will pass through a contamination reduction zone, except in the case of an emergency when it may be necessary to use an alternate exit. All personnel entering the exclusion zone will wear prescribed protective equipment and follow appropriate decontamination procedures upon exiting the exclusion zone and passing through the contamination reduction zone.

3.0 SITE RECONNAISSANCE SURVEYS

Prior to conducting any sampling or subsurface work, site surveys will be conducted to determine the ambient conditions at each site and to aid in the determination of final sample locations. The site surveys will consist of visual, ambient air, radiological, geophysical, and soil gas surveys.

3.1 Visual Survey

A physical walkover of each site will be performed by the TRC field team to familiarize themselves with the individual sites. Site-specific health and safety considerations will be reviewed before and during the walkovers. Appropriate locations for investigation grids will be selected and staked at each site in support of the planned site surveys and sampling activities (e.g., geophysical, soil gas). Designated drum staging locations will be selected and constructed. Clear access for drilling rigs to all planned test boring and well locations will be established during the survey. Surface features such as buildings, manholes, and utilities will also be noted during the visual survey. TRC will coordinate with the Navy to assure that all subsurface investigation activities avoid buried utilities and other similar known potential hazards.

3.2 Ambient Air and Radiological Surveys

An ambient air monitoring survey and radiological emission survey will be conducted at each site as a health and safety precautionary measure. An Organic Vapor Analyzer (OVA) will be used to survey each site to determine on-site background organic vapor conditions. Ambient air monitoring will also be conducted throughout all of the site investigation activities as specified in the project HASP. Although there is no knowledge or record of any radioactive waste being present at any of the sites, a radiological survey will be conducted at each site. Due to the varying nature of the sites, the radiological surveys will consist of a general walkover survey at the two tank farms and Old Fire Fighting Training area and a gridded traverse survey at the two landfills. The general walkover surveys will be conducted in those areas planned for sampling activities. At each of the two landfills, a series of traverses spaced approximately 50 feet apart will be continuously monitored in each survey. The traverse spacing will be modified as is necessary (i.e.,

reduced or concentrated) in those areas where deviations from background readings are observed. The radiological survey will be conducted with a scintillation meter (Ludlum Model 19 Micro R Meter). Meter readings will be monitored throughout each survey, and any deviations from background will be recorded. Background values for the air and radiological surveys will be determined off site before and after each survey.

3.3 Geophysical Survey

A geophysical survey will be conducted at the following three sites: McAllister Point Landfill, Melville North Landfill, and Old Fire Fighting Area. The geophysical survey will be conducted with a Geonics EM-31 electromagnetic (EM) terrain conductivity meter. The EM-31 has a fixed intercoil spacing of 3.7 meters (12 feet) and an effective penetration depth of approximately 6 meters (20 feet). In general, the EM surveys will be used to aid in determining the location and/or extent of buried electrically conductive objects (e.g., tanks, drums, structures) and waste areas (pits, fill). This information will aid in "fine-tuning" the final locations for investigative borings and wells. All geophysical survey findings will be reviewed with representatives of the Navy to evaluate and revise the number and locations of the planned preliminary boring and well locations, as justified by these findings.

As specified above, an EM-31 geophysical survey will be conducted at three of the five sites included in this investigation. The specific purpose of the EM survey varies for each site. An EM survey will be conducted at the McAllister Point Landfill and Melville North Landfill to aid in determining the extent of each landfill. The EM survey will also be used at the Melville North Landfill site to aid in locating waste pits which appear to have existed on a portion of the site (as identified in historical aerial photos of the site). An EM survey will be conducted at the Old Fire Fighting Training Area to aid in locating buried waste and/or underground structures previously associated with the site's operation (as identified in historical aerial photos of the site). At a minimum, the EM surveys will be conducted continuously along traverses spaced approximately 50 feet apart. More detailed EM surveys will be conducted around those areas suspected of having buried object/materials and around those areas of detected anomalies. The

planned locations for the geophysical survey traverses at the three sites are shown in Figure 7, 13 and 20.

A magnetic locator (Schonstedt Model GA-52B) will also be used to investigate those areas of the sites where magnetic anomalies are detected with the EM-31. The magnetic locator is designed to locate buried ferromagnetic objects. The magnetic locator will be used at all of the sites to check all subsurface investigation locations (i.e., borings and test pits) prior to drilling and/or excavation activities for the possible presence of unknown buried utilities and other buried hazards (e.g., drums, tanks). If unknown buried objects are detected at a planned sample location, the sample location will be moved to avoid the detected anomaly.

During all of the geophysical surveys, potential interferences to the survey data such as power lines, fences, and other surficial ferromagnetic objects will be noted in field notebooks.

3.4 Soil Gas Survey

Soil gas surveys will be conducted at the following three sites: Old Fire Fighting Training Area, Tank Farm Four, and Tank Farm Five. In general, soil gas sampling will be used at these sites to aid in defining the presence, nature, and extent of subsurface contamination.

Increased concentrations of gaseous volatile organic compounds are commonly present within the pore space of contaminated unsaturated soils, above contaminated buried wastes, and above ground water contaminant plumes. Analysis of soil gas survey results is typically an effective screening method for determining the presence and extent of an area contaminated with volatile organic compounds. Soil gas sampling is planned for those sites which are known to have volatile organics soil and/or ground water contamination and physical characteristics lending themselves to such a survey (e.g., homogeneous soils, shallow ground water table). The soil gas survey information should aid in directing the surface and subsurface investigation activities at the three sites. All soil gas survey findings will be reviewed with representatives of the Navy to evaluate and revise the number and locations of the planned preliminary boring and well locations, as justified by these findings.

Soil gas sampling is not planned for the two landfill sites. Due to the physical nature of these sites (i.e., nonhomogeneous fill, capped areas), a soil gas survey would not provide information useful to the investigation of either site. Also, given the investigation objectives of each site, a soil gas survey is not necessary for these sites. The geophysical and test boring investigation planned for these sites should provide the information necessary to define the nature and extent of each landfill and direct further investigation activities (i.e., well placement, surface water/sediment sampling).

- Soil Gas Sampling Strategy and Location

Sampling grids will be established at the three sites to characterize the site or particular areas of a site in a systematic manner. In general, the grids will encompass those areas suspected of having contamination. At the Old Fire Fighting Training Area site, the grid will encompass the complete site to aid in locating the sources and extent of contamination. At the two tank farm sites, grids will be established across the site and concentrated around specific areas to determine the presence and extent of contamination around potential contamination sources and across the site.

During the soil gas surveys, the sampling grid will be extended as necessary to sufficiently define areas of volatile organic contamination. Sampling points may be added to provide further definition, as judged necessary by the TRC field team leader. The site-specific soil gas survey descriptions are provided below.

3.4.1 Site 09 - Old Fire Fighting Area

Oil was encountered on the site approximately 5 feet below the surface during a 1987 geotechnical investigation. It is likely that the oil detected at the site is associated with past fire fighting training activities. Historic information indicates that these training activities occurred across the site. Thus, it is likely that volatile organic contamination associated with the fuel or waste oils used in the training operations may exist across the site.

A soil gas survey will be conducted across the site to aid in determining the location of the contamination sources and extent of contamination. The

survey will be conducted on a 100-foot interval grid. The soil gas survey will not be conducted on top of the two soil mounds present at the site. The extent of the survey will be modified (i.e., concentrated), as necessary, in those areas where apparent contamination sources are detected and to aid in defining contamination boundaries. The approximate location of the planned grid is shown in Figure 21.

3.4.2 Site 12 - Tank Farm Four

The underground storage tanks (USTs) at this site are known to have once contained diesel and fuel oil. The results of previous investigations at the site document the presence of petroleum-based hydrocarbons in tank contents and in ground water monitoring wells at the downgradient edge of the site. This information indicates that the ground water at the site is contaminated with volatile organic compounds and that the likely source is the USTs. Based upon the location of the USTs and the existing contaminated monitoring wells, it would appear that ground water contamination exists across the site.

A soil gas survey will be conducted across the site to determine the nature and extent of the ground water contamination. The survey will initially be conducted around each tank, around the oil/water separator and on 400-foot intervals along one traverse downgradient of the main tank area. If the results of the soil gas survey along the one traverse detect the ground water contamination at the site, soil gas sampling will be conducted across the rest of the site on a 400-foot grid. The extent of the survey will be modified (i.e., concentrated), as necessary, in those areas where apparent contamination sources are detected, and to aid in defining contamination boundaries. Soil gas surveys will be conducted around each of the USTs and the oil-water separator to determine the possible sources of ground water contamination (i.e., leaking tank, disposed tank bottom sludge). The surveys at the USTs will be conducted on a concentric 100-foot interval grid around each tank. The first sampling point at each location will be located in what is believed to be the downgradient ground water flow direction so as to aid in determining if a contamination plume is flowing away from the tank. The soil gas survey around the oil/water separator will be spaced around the structure to provide an initial indication of the presence of any subsurface volatile compound contamination around the structure. This plan will result in

four sample points per tank area and four sample points around the oil/water separator. The approximate locations of the planned grids are shown on Figure 27.

3.4.3 Site 13 - Tank Farm Five

USTs at this site are known to have once contained diesel and fuel oil. The results of previous investigations at the site indicate the presence of petroleum-based hydrocarbons (aromatic and/or chlorinated volatile organic compounds) in ground water monitoring wells and USTs at the site. This information indicates that ground water at a portion of the site is contaminated with volatile organic compounds and that the likely source is the nearby USTs. Based upon these findings, and the existence of additional similar USTs across the site, it is considered likely that ground water contamination exists across the site.

A soil gas survey will be conducted across the site to aid in determining the nature and extent of ground water contamination. The survey will initially be conducted around each tank, around the burning pit, and on 400-foot intervals along one traverse downgradient of the main tank area. If the results of the soil gas survey along the one traverse detect the ground water contamination at the site, soil gas sampling will be conducted across the rest of the site on a 400-foot grid. The extent of the survey will be modified (i.e., concentrated), as necessary, in those areas where apparent contamination sources are detected and to aid in defining the contamination boundaries. Soil gas surveys will also be conducted around each of the USTs and the burning pit to determine the possible sources of ground water contamination (i.e., leaking tank, burning pit waste, disposal tank bottom sludge). The surveys at the USTs will be conducted on a concentric 100-foot interval grid around each tank. The first sampling point at each location will be located in what is believed to be the downgradient ground water flow direction so as to aid in determining if a contamination plume is flowing away from the tank. The soil gas survey around the burning pit will be spaced around the structure to provide an initial indication of the presence of any subsurface volatile compound contamination around the structure. This plan will result in four sample points per tank area and four sample points around the burning pit. The approximate location of the planned grids are shown on Figure 31.

- Soil Gas Sampling Method

Soil gas sampling will be accomplished by inserting a steel probe into the ground and withdrawing an air sample from the soil. The depth that the steel probe will be inserted into the ground at each site will be determined after experimenting at a number of different depths. The steel probe will be removed, and a section of Teflon® tubing (with one end closed off and air holes located along the length of the tubing) will be quickly inserted into the hole. The top of the hole will be sealed with an inert plastic putty which will not allow outside air to enter the hole. The Teflon® tubing will be attached to a vacuum pump, and a vacuum will be applied to the tubing. A clamp will then be applied to the Teflon® tubing and the tubing allowed to equilibrate for a defined period of time (approximately 10 to 20 minutes). The soil gas inside of the Teflon® tubing will be sampled with a 50 cc sterile glass syringe. The soil gas sample will then be injected into a portable gas chromatograph (GC) and analyzed for volatile organic compounds. The calibration procedures and associated quality assurance/quality control (QA/QC) for the portable GC are contained in Volume III - QA/QC Plan of this Work Plan.

- Soil Gas Sample Designation

Each soil gas sampling grid point will have an established alpha-numeric reference system consisting of letters starting from "A" and increasing along one axis and numbers starting from "1" and increasing along the other perpendicular axis. When several grids are established on one site, each grid will be assigned a number which will precede the sample activity designation. Each sample will have a designated field identification number which will reference the site name, sample number, grid number, grid point, and sample date. Below is an example of the planned soil gas sample designation scheme.

Example: TF4-1SG-M6-51089

where: TF4 = Tank Farm Four
1 = Grid Number (necessary only if multiple grids on a site)
SG = Soil Gas Sample
M6 = Grid Point
51089 = Sample Date

4.0 FIELD SAMPLING ACTIVITIES

The planned field sampling activities include surface soil sampling, test pit sampling, test boring soil sampling, well boring soil sampling, monitoring well ground water sampling, surface water sampling, sediment sampling, biota sampling, and tank/structure sampling. This sampling plan presents the minimum investigation effort believed necessary to evaluate the contamination at each site. The sampling effort will be expanded as is indicated necessary by the findings and sample results of the initial investigation activities. A summary of the planned field investigation activities is presented in Table 3 at the end of this section.

4.1 Surface Soil Sampling

Surface soil samples will be collected from each of the five sites. Surface soil sampling activities will concentrate on those areas surrounding possible and/or known contamination sources (e.g., tanks, pits, landfills). In general, surface soil sampling will be conducted to aid in determining the presence, nature, and extent of surface soil contamination at each site. This information will aid in meeting the overall sampling objectives stated in Section 3.1 of this report. Information obtained from the initial site surveys may be used in fine tuning the final surface soil sample locations at each site.

- Surface Soil Sampling Strategy and Location

Limited soil sampling has been conducted at several of the sites being investigated. When appropriate, the results of previous investigations were used in establishing the surface soil sampling strategy for each site. Surface soil samples will be collected and analyzed as discrete and composite samples. The specific surface soil sampling scheme for each site is presented below.

4.1.1 Site 01 - McAllister Point Landfill

Surface soil samples will be collected from fifteen (15) locations on-site and two locations off-site. The fifteen on-site surface soil samples will be collected outside of established fill areas, and the two off-site surface soil samples will be collected from areas representative of background conditions. Although a composite soil sample was collected from the site in a previous

investigation and was found to have no detectable priority pollutants, it is believed that this sample is representative of the landfill cap material, not contaminated source material. The planned fifteen surface soil samples will be collected from locations outside of the capped landfill area. The approximate locations for these surface soil samples are shown on Figure 13.

Due to the unknown nature of material deposited in the landfill and the lack of representative surface soil data from previous investigations, all of the surface soil samples collected from this site will be analyzed for the full list of Target Compound List (TCL) parameters and archived for possible dioxin and furan analyses. The sample analyses results will be reviewed to determine if dioxin and furan analyses are appropriate for any of the samples based upon the detected TCL compounds. The target compound list includes both organic and inorganic compounds. A list of the TCL parameters is provided in Section 5.0 of Volume III - QA/QC Plan of this Work Plan. The two off-site surface soil samples will be analyzed for TCL metals to provide an indication of background metal concentrations in area soils.

4.1.2 Site 02 - Melville North Landfill

Fifteen (15) surface soil samples will be collected from across the site. The fifteen surface soil samples will be collected outside of established fill areas. The approximate locations for the surface soil samples are shown on Figure 14.

Previous surface soil sampling was conducted at the site in and around the area containing visible oily deposits. In the Verification Step of the Confirmation Study, one composite sample collected from the oily deposits was found to contain lead and very high concentrations of petroleum-based hydrocarbons. No polychlorinated biphenyls (PCBs) were detected in the sample. In the Characterization Step of the Confirmation Study, a visual field investigation was conducted to determine the extent to which oil from the deposits had contaminated nearby soil. The results of the visual field observations stated that "oily material has not migrated laterally away from the surface piles of the soil". These visual observations were not confirmed by any soil sample laboratory chemical analyses.

The results of the Confirmation Study provide a gross indication of the presence of contamination in the visible oily deposits investigated at the site. A lack of full scan chemical analyses on the waste deposit samples and any analyses on adjacent soil samples indicates the need for additional sampling and analyses in the area. This area will be investigated by TRC under a separate service contract for the removal of the oily deposits.

Due to the unknown nature of materials deposited in the landfill, all of the fifteen surface soil samples will be analyzed for the full list of TCL parameters and archived for possible dioxin and furan analyses. The sample analyses results will be reviewed to determine if dioxin and furan analyses are appropriate for any of the samples based upon the detected TCL compounds.

4.1.3 Site 09 - Old Fire Fighting Training Area

Surface soil samples will be collected from six (6) locations across the site. The samples will be collected from those areas of concern with respect to human exposure (e.g., child care center, baseball field, park) and other areas which may provide an indication of areal surface soil contamination (e.g., rainfall runoff paths, stressed vegetation, soil mounds). At a minimum, the following six surface soil samples will be collected from the site: one composite samples from the ball park area, one composite samples from the child care center area, one composite samples from the park pavilion area, one composite samples from the shoreline area, one composite samples from the large soil mound in the center of the site and one composite sample from the soil mound on the western end of the site. The approximate locations for these surface soil samples are shown in Figure 22.

It appears that the original fire training area has been covered with soil fill and revegetated to facilitate the use of the property as a park and child care center. Thus, it is likely that most of the near-surface soils now at the site are not those that were present during the site's operation. Therefore, it is possible that no near-surface soil contamination exists at the site; however, this needs to be confirmed for public health risk assessment purposes. If surface soil contamination is detected in any of the planned surface soil samples, additional follow-up surface soil sampling will be conducted to determine the full nature and extent of the surface soil contamination at the site.

Given the fact that subsurface soil contamination has been documented at the site and that no chemical analyses were conducted on samples from the site, all of the surface soil samples will be analyzed for the full list of TCL parameters and archived for possible dioxin and furan. The sample analyses results will be reviewed to determine if dioxin and furan analyses are appropriate for any of the samples based upon the detected TCL compounds.

4.1.4 Site 12 - Tank Farm Four

Previous surface soil sampling activities conducted at the site during the Verification Step of the site's Verification Study included the collection of one composite soil sample. The composite soil sample was comprised of soil collected near six of the tanks on the site. Sample analyses results indicated elevated concentrations of lead and oil/grease in the soil. Samples collected during the Confirmation Study from on-site sediment, ground water monitoring wells, and tanks were found to contain detectable concentrations of petroleum-based hydrocarbons. This information indicates that petroleum-based contamination does exist at the site and requires further investigation.

It is known that petroleum products (e.g., fuel oil, diesel) were handled and stored at the site; however, the locations of past tank sludge disposal/burning areas at the site are unknown. Therefore, surface soil sampling will be conducted in a phased approach to aid in establishing a more systematic soil investigation for locating these areas. Initially, samples will be collected to determine the presence of petroleum contamination around each tank, in areas between the tanks, and around the oil/water separator at the site. These samples will only be analyzed for the indicator analysis of total petroleum hydrocarbons (TPH) and for lead. The information obtained from these analyses will be used to focus the full TCL parameter surface soil sampling activities.

Based upon the phased sampling approach discussed above, a total of approximately thirty (30) surface soil samples will initially be collected across the site. It is estimated that these soil samples will be collected as follows: two from around each tank, four from around the oil/water separator, and the rest from other areas of suspected contamination (i.e., visible contamination, stressed vegetation). The two surface soil samples from around

each tank will consist of one composite sample from the whole tank area and one discrete sample from any area observed to have signs of contamination (e.g., stains, stressed vegetation). In the follow-up sampling, it is estimated that a total of approximately eighteen (18) soil samples will be collected from across the site. These samples will be collected from in and around those areas found to have elevated TPH and/or lead concentrations. It is estimated that these samples will be collected as follows: one from around each tank, two from around the oil/water separator, and the rest from areas of detected TPH contamination. These samples will be analyzed for the full list of TCL parameters. It is important to note that if the initial phase TPH and lead sample results indicate that no contamination is present in a particular area, no additional TCL surface soil sampling will be performed in the area unless other information (e.g., soil gas results) indicates the need for such sampling.

4.1.5 Site 13 - Tank Farm Five

The results of previous investigation activities conducted at the site during a tank closure study indicated that volatile organics and metals contamination of the ground water exists at the site. Soil samples have not been collected from the site for analyses; however, given the past tank sludge disposal/burning operations which reportedly occurred at the site, surface soil contamination is very likely.

Petroleum products (e.g., fuel oil, diesel and waste oils) were handled and stored in USTs at the site. During the operation of the tank farm, sludge collected from the USTs was reportedly burned in an on-site burning pit. The burning pit's location is identifiable in the field. It is not known if any of the tank sludge burning operations occurred near any of the tanks, as was reportedly the case at Tank Farm Four. Therefore, surface soil sampling will be conducted in a phased approach similar to that planned for Tank Farm Four. The slight difference between the two plans is that surface soil sampling will be conducted around the burning pit at this site instead of an oil/water separator. Given this difference, the surface soil sampling approach provided in the Tank Farm Four section, Section 4.1.4, will be followed at Tank Farm Five.

- Surface Soil Sampling Methods

Samples to be analyzed for total petroleum hydrocarbons and volatile organics will be collected with a hand auger and dedicated stainless steel spoon from a depth of 6 to 12 inches. These samples will be transferred directly to the appropriate sample container to minimize the loss of volatile compounds from the sample. All other surface soil samples will be collected directly from the ground surface with a dedicated stainless steel spoon. When composite soil samples are collected, the compositing of the soil samples will be performed by collecting an equal amount of sample from each location and placing the samples into a decontaminated stainless steel bowl, and mixing them thoroughly with a dedicated stainless steel spoon. Each composite sample will consist of four aliquots collected from four adjoining quadrants of approximately equal area. Discrete soil samples will be collected for the petroleum hydrocarbons and volatile organic compounds analyses.

All sampling devices (i.e., hand augers, spoons) will be decontaminated prior to each use according to the procedures described in the project QA/QC Plan. Surface soil sampling will be performed according to procedures described in Method II-1, provided in Appendix A, as adopted from EPA's Sites Characterization Methods Manual (EPA, 1984).

- Surface Soil Sample Designation

All surface soil samples will be assigned a designated field identification number which will reference the site name, sample type, sample location number, and sample date. Below is an example of the planned surface soil sample designation scheme:

Example: TF4-SS1-51789

where: TF4 = Tank Farm Four
SS = Surface Soil Sample
1 = Sample Location Number
51789 = Sample Date

4.2 Surface Water, Sediment, and Biota

Surface water, sediment, and/or biota samples will be collected from each of the five sites. These samples will be collected to determine if contamination has migrated from each site into surface water adjacent to or on

a site. The sediment and mussel sample data will indicate whether contamination is accumulating in these medium and is a threat to the public health and environment.

- Surface Water Media Sampling Strategy and Location

Previous surface water related studies have been completed at several of the sites being investigated. Sediment and mussel sampling has been conducted in the bay adjacent to both of the landfill sites. Limited surface water and sediment sampling has been conducted at the Tank Farm Four site. No surface water related sampling has been conducted at the Old Fire Fighting Area site or the Tank Farm Five site. The results of the previous site investigations were used in establishing the planned surface water related sampling scheme for each site. The specific sampling scheme for each site is presented below.

4.2.1 Site 01 - McAllister Point Landfill

Sediment and biota samples will be collected from Narragansett Bay adjacent to the landfill. Previous site investigations have found elevated levels of metals in the bay sediments and mussels adjacent to the site. The latest investigation conducted in 1988 by the U.S. Army Corps of Engineers found that elevated concentrations of PCBs and petroleum hydrocarbons were present in the adjacent bay sediments. Slightly elevated concentrations of PCBs were also detected in the mussel samples. The results of the studies indicates that the landfill is a source of contamination to the bay and that there is a need to investigate the full nature and extent of this contamination.

Sediment and biota samples will be collected from twenty (20) locations in the bay adjacent to the site and from (two other locations) ^{backgrounds.} in the bay. When present, both mussels and hard shell clams will be collected during biota sampling. Fifteen (15) sediment and biota sample locations are separated by either 50-, 100-, or 200-foot intervals on the bay shoreline along the edge of the landfill. These shoreline samples will all be collected from locations just within the water's edge at high tide. A majority of these 15 locations are concentrated (i.e., 50- and 100-foot interval spacing) in those areas where the most elevated levels of mussel and sediment contaminants were detected in previous investigations. Five (5) additional sample locations are planned for points in these same areas, but approximately 200 feet out in the

bay. An additional five (5) optional sampling locations are located approximately 400 feet from the shoreline. Samples will be collected from these five optional locations if justified by the results of those samples collected for analyses. The planned sample locations are shown on Figure 11. Sediment and biota samples will also be collected from two other locations in the bay considered to be representative of background conditions.

Two sediment samples will be collected from each sample location; one from depth of 0 to 1.0 foot and one from a depth of 1.0 to 2.0 feet beneath the sediment surface. All sediment and biota samples will be analyzed for TCL semi-volatile organics, inorganics, and PCBs. The sediment samples will also be analyzed for TCL volatile organic compounds. The analytical results of the sediment and biota samples will provide information on the nature and extent of contamination in the bay adjacent to the site.

→ Leachate samples will also be collected from any leachate springs emanating from the landfill. Two such leachate springs were sampled in a previous investigation and found to have elevated concentrations of inorganic and organic compounds. All leachate springs will be sampled during this site investigation. It is assumed that two leachate springs will be present during the investigation. Their expected locations are the same as those previously sampled, as is shown on Figure 11. All leachate samples will be analyzed for the full list of TCL parameters.

4.2.2 Site 02 - Melville North Landfill

Sediment and biota samples will be collected from Narragansett Bay adjacent to the landfill. Sediment samples will also be collected from a wetlands area adjacent to the site. Previous site investigations did not detect any elevated concentrations of metals or PCBs in sediments and mussels in the bay adjacent to the site. The scope (i.e., sample number and analyses) of the previous investigation was limited and, therefore, did not conclusively document that the landfill is not a source of contamination to the bay. Sediment and biota samples will be collected during the site investigation to determine if the landfill has contributed contamination to the bay.

Sediment and biota samples will be collected from seven (7) locations in the bay adjacent to the site. When present, both mussels and hard shell clams

will be collected during biota sampling. Five (5) of the sample locations are separated by 300-foot intervals on the bay shoreline along the edge of the landfill. These shoreline samples will be collected from locations just within the water's edge at high tide. The other two (2) sediment and biota sample locations are planned for points in the bay approximately 200 feet from the sites' shoreline. The planned sample locations are shown on Figure 18. Sediment and biota samples will be analyzed for TCL semi-volatile organic, inorganic, and PCB compounds. The sediment samples will also be analyzed for TCL volatile organic compounds. The planned sample locations are spaced along the site such that their analytical results should provide an indication of the presence of contamination in the bay adjacent to the landfill.

Three sediment samples will also be collected from the wetlands area just north of the site. These samples will be collected from three locations within the wetlands; two locations just adjacent to the site and one location on the northern edge of the wetlands furthest from the site. The planned sample locations are shown on Figure 18. These sediment samples will be analyzed for the full list of TCL parameters. The analytical results of these samples will provide an indication of whether or not the landfill has contaminated the wetland area.

4.2.3 Site 09 - Old Fire Fighting Training Area

Sediment and biota samples will be collected from Narragansett Bay adjacent to the site. When present, both mussels and hard shell clams will be collected during biota sampling. Previous environmental investigations have not been conducted at this site and, therefore, the condition of bay sediments and biota in this location has not been evaluated.

Sediment and biota samples will be collected from eight (8) locations in the bay adjacent to the site. When present, both mussels and hard shell clams will be collected during biota sampling. Five of the locations are separated by 200-foot intervals on the bay shoreline along the edge of the site. These shoreline samples will be collected from just within the water's edge at high tide. The other three sample locations are planned for points in the bay approximated 200 feet from the sites' shoreline. The planned sample locations are shown on Figure 25. The sediment and biota samples will be analyzed for

TCL semi-volatile organic, inorganic, and PCB compounds. The sediment samples will also be analyzed for TCL volatile organic compounds. The planned sample locations are spaced along the site such that their analytical results should provide an indication of the presence of contamination in the bay adjacent to the site.

4.2.4 Site 12 - Tank Farm Four

Sediment and surface water samples will be collected from the brook (Normans Brook) which runs through a portion of the site and into Narragansett Bay. A previous investigation at the site included the collection of one sediment sample from the brook and the collection of a sediment and surface water sample from a ground water swale near the brook. The analytical results of the swale samples document that petroleum-based hydrocarbon contamination exists in the sediments and surface water in the swale. The sediment sample from the brook was not analyzed. The swale is upgradient of the nearby brook and it is likely that the water from the swale flows into the brook. It is also possible that the brook is a "gaining stream" in that it is hydraulically connected to and receives water from the ground water. Given that the site ground water is documented as being contaminated and the likelihood that the brook is contaminated, the sediments and surface water in the brook should be investigated. The source, nature, and extent of the brook contamination will be determined during the site investigation.

Four of the brook sample locations are on-site, one is off-site and upstream, and the other is off-site and downstream at the mouth of the brook. Surface water samples will be collected from three of the locations. Sediment samples will be collected from all of the locations. The planned sample locations are shown on Figure 29. Two sediment samples will be collected from each location; one from 0 to 1.0 foot and the other from 1.0 to 2.0 feet below the sediment surface. All surface water and sediment samples will be analyzed for the full list of TCL parameters (less pesticide fraction).

The presence of a hydraulic connection between the brook and ground water will be investigated at the site. At the four on-site brook sampling locations, a graduated stake will be driven into the brook. A well point will then be driven into the stream bank adjacent to each calibrated stake so that the well point penetrates the water table. Water elevations will be

simultaneously measure in the brook and the well point. The location and elevation of all well points and stakes will be surveyed by a surveyor. The water elevation measurements will be taken at the same time of the site monitoring well water measurements (i.e., minimum of once per month over a 3-month period). These water elevation measurements should indicate whether there is a vertical hydraulic gradient present beneath the brook and thus an interconnection between the brook and ground water.

4.2.5 Site 13 - Tank Farm Five

Sediment and surface water samples will be collected from the brook (Gomes Brook) which runs through a portion of the site and into Narragansett Bay. A previous investigation at the site did not include an investigation of the brook. Samples will be collected from the brook to determine the presence of contamination in the brook.

Sediment and surface water samples will be collected from five locations along Gomes Brook. Three of the location are on the site, one of the locations is off-site and upstream, and the other is off-site and downstream at the mouth of the brook. The planned sample locations are shown on Figure 33. The surface water and sediment samples will be analyzed for total petroleum hydrocarbons and lead. The sediment samples will also be analyzed for PCBs. The results of these selected sample analyses will be used to determine whether contamination is present in the brook, and whether additional sampling is necessary to characterize the contamination.

The presence of a hydraulic connection between the brook and ground water will be investigated at the site. At the three on-site brook sampling locations, a graduated stake will be driven into the brook. A well point will then be driven into the stream bank adjacent to each calibrated stake so that the well point penetrates the water table. Water elevations will be simultaneously measure in the brook and the well point. The location and elevation of all well points and stakes will be surveyed by a surveyor. The water elevation measurements will be taken at the same time of the site monitoring well water measurements (i.e., minimum of once per month over a 3-month period). These water elevation measurements should indicate whether there is a vertical hydraulic gradient present beneath the brook and thus an interconnection between the brook and ground water.

- Surface Water Medium Sampling Methods

Surface water samples will be collected directly in the appropriate sample containers. The pH will be measured to the nearest tenth of a standard unit using an Orion Model 407A Ion-Specific meter or equivalent. Specific conductance will be measured with a YSI conductivity meter or equivalent. A graduated stake will be driven into the sediments at each surface water sample location for recording the depth of water at the time of sampling and for future reference in locating the sample location.

Sediment samples will be collected with a hand corer sampling device. The hand coring device will be equipped with a top-mounted check valve to prevent sample washout during sample retrieval through the overlying water layer. Sediment sampling will be performed according to procedures described in Method II-4 provided in Appendix A of this plan, as adapted from EPA's Sites Characterization Methods Manual (EPA, 1984). During previous surface water investigations near the McAllister Point Landfill, it was noted that a coring device could not be used to collect sediment samples due to a large quantity of stones in the bay sediments. In this case, sediment samples will be collected with a spade and spoon as described in Method II-1, provided in Appendix A of this plan, as adapted from EPA's Site Characterization Methods Manual (EPA, 1984). All sediment samples will be screened with an OVA immediately upon collection and all readings recorded. The physical characteristics of each sediment sample will also be recorded.

Mussels and hard shell clams will be collected by hand or with a dredge sampler. An attempt will be made to collect all mussels and clams at a particular sample station within a 20-foot radius of that station. A sufficient amount of sample, to be specified by the laboratory, will be collected to perform the planned biota sample analyses. The specific sampling and analyses procedures for all biota sampling will be developed in coordination with representatives of the Narragansett Bay Project.

- Surface Water Medium Sample Designations

All sediment, surface water, and mussel samples submitted for laboratory analyses will be assigned a designated field identification number which will reference the site name, sample type, sample location, sample number, and

sample date. Below are examples of the planned sediment, surface water, and mussel sample designation scheme:

Sediment Samples:

Example: MN-SD1-60189

where: MN = Melville North Landfill
SD = Sediment
1 = Sample Number
60189 = Sample Date

Surface Water Samples:

Example: MN-SW1-60189

where: MN = Melville North Landfill
SW = Surface Water
1 = Sample Number
60189 = Sample Date

Mussel Samples:

Example: MN-MS1-60189

where: MN = Melville North Landfill
MS = Mussel
1 = Sample Number
60189 = Sample Date

4.3 Test Pits

Test pit investigation and sampling activities will be conducted at the Melville North Landfill site. Test pits will be excavated to visually investigate the presence and areal extent of lagoons observed on historical aerial photos of the site. The vertical extent of contamination associated with the lagoons will be determined in the test boring investigation as presented in Section 4.3.2 of this report. The findings of the test pit investigation will be reviewed with representatives of the Navy to evaluate and revise the number and locations of the planned, preliminary boring and well locations at this site, as is justified by the findings.

- Test Pit Sampling Strategy and Location

The specific test pit investigation activities planned for this site are described below.

4.3.1 Site 02 - Melville North Landfill

It appears that lagoons at one time existed in the east-central portion of the site. A historical aerial photograph of the site shows what appears to be two lagoons on the site. The southern-most lagoon appeared to have dimensions of approximately 40 feet by 20 feet, while the northern-most had dimensions of approximately 25 feet by 15 feet. The lagoons were separated by approximately 15 feet. Although an area of stressed vegetation is currently visible in the field in the area, the locations of the lagoons are not readily apparent. The planned area for test pits is shown on Figure 15.

A maximum of four (4) soil samples will be collected from the test pits. Two samples will be collected from each of the suspected lagoon areas. The two samples will consist of a soil and sludge sample; if both media are not found in the lagoon areas, then only one soil sample will be collected from each lagoon. All of the samples collected will be analyzed for the full list of TCL parameters and TCLP leachate parameters. The samples will also be archived for possible dioxin and furan analyses. The sample analyses results will be reviewed to determine if dioxin and furan analyses are appropriate for any of the samples based upon the detected TCL compounds.

All excavated test pit soil will be placed on tarps located near the test pits. Visually contaminated and non-contaminated soil will be segregated as much as possible during the placement of the excavated soil on the tarps. Upon completion of test pitting activities, all of the excavated soil will be used as backfill in its respective test pit. If the waste lagoons are located, their boundaries will be staked for future reference.

- Test Pit Sampling Method

Test pit excavation activities will be conducted with a backhoe. Several test pits will be excavated to a maximum depth 4 feet or the ground water table, whichever is encountered first. The test pits will consist of 4-foot wide trenches spaced approximately 20 feet apart and running in an east-west direction. Information obtained from the geophysical survey in this area may aid in determining the former lagoon locations and, thus, the test pits.

The test pit samples will be collected directly from the backhoe bucket with a dedicated stainless steel spoon. All samples will be collected from

the middle of the bucket so as to obtain a sample which has not contacted the backhoe bucket. The depth and location from which each sample is collected will be noted in a field notebook. All test pit excavations will be photographed.

- Test Pit Sample Designation

All test pit samples will be assigned a designated field identification number which will reference the site name, sample type, sample location number, and sample date. Below is an example of the planned test pit sample designation scheme:

Example: MN-TP1-52889

where: MN = Melville North Landfill
TP = Test Pit Sample
1 = Sample Location Number
52889 = Sample Date

4.4 Test Borings

Subsurface test borings will be completed at the McAllister Point Landfill site, Melville North Landfill site, and Old Fire Fighting Training Area site to aid in determining the nature and extent of contamination at each site. Information obtained from the test boring activities will be used to establish a ground water monitoring network at the site. In instances where test boring findings indicate an ideal location for a well (i.e., high levels of contamination observed in fill or aquifer), the test boring may be used for ground water monitoring well installation. Although depending upon the differences in the test boring and well boring drilling specifications (e.g., hole size, hole depth) the test boring may require modifications which may not be possible with the test boring drill rig. A monitoring well would then be installed in the approximate test boring location of interest during the well installation activities.

- Test Boring Sampling Strategy and Location

The specific test boring investigation activities planned for the sites are detailed below.

4.4.1 Site 01 - McAllister Point Landfill

As is discussed in Section 1.0 of this work plan, this landfill received all of the wastes generated at the NETC for a period of almost twenty years. The landfill is believed to contain spent acids, waste paints, solvents, and waste oils. The landfill also reportedly contains at least 200 gallons of PCB-contaminated oil.

Previous subsurface investigation activities at the site included the installation of two on-site monitoring wells and one off-site background well, and the collection of landfill leachate samples. The two on-site wells are located at the southwestern edge of the landfill portion reportedly used for the disposal of hazardous wastes. The borings associated with the wells encountered 15 to 38 feet of fill material (e.g., bricks, wood, fabric) on the site. No samples were collected from the soil or fill material for laboratory analyses. Ground water elevation measurements from the wells indicate that the water table is within the fill material. The results of the ground water monitoring well sample analyses indicate elevated concentrations of metals in the site ground water. The analytical results of the leachate samples collected from springs emanating from the western edge of the landfill also tend to indicate that volatile organic and metal-containing waste is present in the landfill.

The above information indicates the need for determining the nature and extent of subsurface contamination at the site. The test boring activities will include the drilling and sampling of at least ten (10) borings across the site. Another ten locations are planned for optional test borings if the findings of the initial ten borings indicate the need for additional information in the areas. Although borings will not be completed in those areas where the geophysical surveys indicate the presence of buried metallic objects (e.g., drums), such locations will be staked for future reference. The planned test boring locations are shown on Figure 9.

Continuous split spoon sampling will be conducted in all of the test borings. The borings will be completed to a depth of just beyond the observed fill material. As previously mentioned, the waste fill at the site is known to be from 15 to 38 feet deep. The test borings found to be outside of the

CONTINUOUS SPOONS
15 - 38 FT. OF FILL
10 BORINGS (+ 10 optional)

fill material will be completed to a depth of six (6) feet to investigate the near-surface soil at the edges of the landfill. If signs of soil contamination are observed to a depth of 6 feet in these borings, they will be completed to just beyond the depth of observed contamination. A total of two to three samples will be collected for analyses from each of the test borings completed in the fill area. All of the split spoon samples will be screened with an OVA and radiation scintillation meter for signs of contamination. The three samples which will be submitted for analyses from these borings will include a sample from the fill material, a sample at the ground water table, and a sample from the soil just beneath the fill material. If these first two samples (i.e., the one in the fill material and one at the water table) appear to be of the same fill material, only the sample at the ground water table will be submitted for analyses. The fill material sample will be collected from the split spoon that appears to be the most contaminated based upon visual observations and OVA readings. Only one soil sample will be collected from those borings found to be outside of the fill area. This sample will be collected from the first spoon to investigate the near-surface soil contamination in the area. If signs of contamination are observed in one of the spoons collected from these shallow borings, a sample will also be collected from that spoon for analyses. All samples will be analyzed for the full list of TCL parameters. ~~All of the samples collected from the fill material will also be analyzed for 2,3,7,8-TCDD (dioxin).~~ All other samples will be archived for dioxin analysis. The sample analyses results will be reviewed to determine if dioxin and furan analyses are appropriate for any of the samples based upon the detected TCL compounds. A select number (assumed 50%) of the fill samples will also be archived for possible dioxin and furan analyses. The samples selected for the TCLP analyses will consist of those samples which appear (visually and monitored) to be the most contaminated.

4.4.2 Site 02 - Melville North Landfill

As is discussed in Section 1.0 of this work plan, this landfill received wastes generated at the NETC for a period of nearly 15 years. The landfill is believed to contain wastes similar to the McAllister Point Landfill; spent acids, waste paints, solvents, waste oils, and PCB oil.

Subsurface investigation activities have not been completed at this site; however, surficial sampling of oily deposits at the site indicated the

presence of petroleum-based hydrocarbons and metals in the deposits. The unknown nature of the landfill indicates the need for determining the nature and extent of subsurface contamination at the site. Test boring activities will include the drilling and sampling of at least ten (10) test borings across the site. As is mentioned in Section 4.2.1, several of the borings are planned for an area of the site where test pits will be excavated to investigate the location of the former waste lagoons. Another six locations are planned for optional test borings if the findings of the initial ten borings indicate the need for additional information in the areas. Although borings will not be completed in those areas where the geophysical surveys indicate the presence of buried metallic objects (e.g., drums), all such locations will be staked for future reference. The planned test boring locations are shown on Figure 16.

Continuous split spoon sampling will be conducted in all of the test borings. The borings will be completed to a depth of just beyond the observed fill material. The depth of fill at the site is unknown. The test borings found to be outside of the fill material will be completed to a depth of six (6) feet to investigate the near-surface soil at the edges of the landfill. If signs of soil contamination are observed to a depth of 6 feet in these borings, they will be completed to just beyond the depth of observed contamination. A total of two to three samples will be collected for analyses from each of the test borings completed in the fill area. All of the split spoon samples will be screened with an OVA and radiation scintillation meter for signs of contamination. The three samples which will be submitted for analyses from these borings will include a sample from the fill material, a sample from the ground water table, and a sample from the soil just beneath the fill material. If these first two samples (i.e., the one in the fill material and one at the water table) appear to be of the same fill material, only the sample at the ground water table will be submitted for analyses. The fill material sample will be collected from the split spoon that appears to be the most contaminated based upon visual observations and OVA readings. Only one soil sample will be collected from those borings found to be outside of the fill. This sample will be collected from the first spoon to investigate the surface soil contamination in the area. If signs of contamination are observed in one of the spoons collected from these shallow borings, a sample

will also be collected from that spoon for analyses. All samples will be analyzed for the full list of TCL parameters. All of the samples collected from the fill material will also be archived for possible dioxin and furan analyses. The sample analyses results will be reviewed to determine if dioxin and furan analyses are appropriate for any of the samples based upon the detected TCL compounds. A select number (assumed 50%) of the fill samples will also be analyzed according to and for those parameters listed under the Toxicity Characteristic Leaching Procedure (TCLP) test. The samples selected for the TCLP analysis will consist of those samples which appear (visually and monitored) to be the most contaminated.

4.4.3 Site 09 - Old Fire Fighting Training Area

Previous subsurface investigation activities at this site included the drilling of three test borings during a 1987 geotechnical investigation. Oil was encountered on the site approximately 5 feet below the surface during the investigation. Bedrock at the site was also encountered at depths from approximately 5 to 10 feet. Numerous below-grade structures (e.g., pumps, pits) were used at the site during fire fighter training operations. It is likely that these structures and surface discharges were sources of oil contamination resulting from the training operations which occurred at the site for almost 30 years.

The above information indicates the need for determining the nature and extent of subsurface contamination at the site. Also, the fact that subsurface oil was encountered south of the primary training area of the site, indicates the possibility of widespread on-site contamination. The test boring activities may include the drilling of at least seven (7) test borings at the site. The borings will be drilled across the site with a higher percentage located in those areas suspected of having contamination (e.g., former pit and tank locations). Another thirteen locations are planned for optional test borings if the findings of the initial seven borings indicate the need for additional information in the areas. The planned test boring locations are shown on Figure 19. The geophysical and soil gas survey information will be used to define the final scope of the test boring investigation. It is expected that the geophysical and soil gas surveys will provide sufficient information to locating subsurface contamination sources

and defining the extent of subsurface contamination. The test boring investigation will then be used to confirm the results of these surveys and provide locations from which to collect subsurface soil samples which would be representative of site contamination.

Continuous split spoon sampling will be conducted in all of the test borings. The borings will be completed to just beyond observed contamination or the depth of the bedrock, whichever is encountered first. If no contamination is observed in a boring, the boring will be completed to bedrock. A total of one to two soil samples will be collected for analyses from each test boring. All of the split spoon samples will be screened with an OVA for signs of contamination. The two soil samples which will be submitted for analyses will include a sample from the area of highest observed contamination and one from just beneath the zone of visible contamination. If contamination is only observed in the sample collected at the ground water table, (i.e., no likely contamination source at the location) only that sample will be collected for analyses from the test boring. These samples will be analyzed for the full list of TCL parameters. It is assumed that this will consist of one (1) such sample per boring. All test boring soil samples will also be archived for possible dioxin and furan analyses. The sample analyses results will be reviewed to determine if dioxin and furan analyses are appropriate for any of the samples based upon the detected TCL compounds. If no contamination is observed in a test boring, one sample will be collected for total petroleum hydrocarbon analyses at the ground water table. The final test boring investigation details (i.e., boring number and location) will be determined after the geophysical and soil gas survey data for the site is evaluated.

- Test Boring Sampling Methods

Split spoon samples will be collected at 2.0-foot intervals from each borehole. Standard penetration tests [ASTM 1586-67 (1974)] will be conducted for every 2.0-foot sampling interval. The physical characteristics of each soil sample will be visually classified and described based upon the Unified Soil Classification System [ASTM D2487]. Soil samples to be submitted for laboratory analyses will be transferred from the split spoon to the sample container with a dedicated stainless steel spoon. All sampling equipment

(i.e., augers, drilling rods, spoons) will be decontaminated prior to each use according to the procedures described in the project QA/QC Plan. All split spoon samples will be monitored with an OVA and scintillation meter. All field observations will be recorded in a field notebook.

The drill cuttings from each site's test borings will be handled differently. The cuttings from the two landfills will be returned into their respective borings. Given the open public access to the Old Fire Fighting Training Area site, special sampling procedures will be used to eliminate the potential for public exposure to contamination during and after the site investigation. During all drilling activities, plywood and plastic sheeting will be placed around each borehole to intercept the drill cuttings and eliminate the potential for spreading contamination around the borehole. All test boring drill cuttings will be backfilled into their respective borings. To eliminate potential future human exposure to contaminated drill cuttings, all borings at the Old Fire Fighting Training Area site will be backfilled to within 1.0 foot of the ground surface, after which a cement-bentonite grout will be used to "top-off" the hole. Any remaining drill cuttings will be contained in labelled DOT-approved 55-gallon drums. The drill cutting drums from the Old Fire Fighting Training Area will be stored in a designated drum staging area which will be located on Tank Farm Five.

- Test Boring Sample Designation

All test boring soil samples submitted for laboratory analyses will be assigned a designated field identification number which will reference the site name, sample type, sample location, sample number, and sample date. Below is an example of the planned test boring soil sample designation scheme:

Example: TF4-TB12-52589

where: TF4 = Tank Farm Four
TB = Test Boring Soil Sample
1 = Sample Location Number
2 = Sample Interval
52589 = Sample Date

4.5 Monitoring Wells

Monitoring wells will be installed at all five sites to aid in determining the nature and extent of ground water contamination at each site. The

monitoring wells will also be used to provide information on the aquifer characteristics at each site. Four separate discussions on the monitoring well investigations are presented below concerning the following: well sampling strategy and location for each site, well construction details, well sampling methods, and the well sample designation scheme.

- Monitoring Well Sampling Strategy and Location

Several monitoring wells have already been installed and sampled at three of the five sites. These wells will be used in the site investigations. Previous information from the wells was used in establishing the planned well network for these sites. The proposed monitoring well network for all of the sites is based upon the information known to date about each site and the ground water monitoring objectives. Information obtained from initial site investigation activities (e.g., test borings, soil gas sampling) will be used to "fine tune" the final well network for the sites, as justified by the information. The monitoring well investigation activities planned for each site are detailed below.

4.5.1 Site 01 - McAllister Point Landfill

3 EXISTING WELLS SAMPLED
9 NEW WELLS 6 SOIL, 3 BEDROCK

A total of eight (8) monitoring wells will be installed on the site and one (1) off-site (upgradient) to investigate the ground water contamination at this site. Two wells were previously installed on-site and one well off-site (upgradient). The two on-site wells are approximately 300 feet apart along the southwestern edge of the site bordering Narragansett Bay. The off-site well is approximately 300 feet northeast and upgradient of the site. The analytical results of the water samples from these wells indicted that elevated concentrations of metals exist in the site ground water. Samples collected from leachate springs flowing from the western edge of the landfill indicate that organic and inorganic contamination is emanating from the landfill. These results, and the nature of the wastes disposed of at the landfill indicate the need for investigating the ground water at the site.

The nine wells to be installed at the site will consist of six wells screened in the unconsolidated overburden fill materials and three wells screened in the bedrock, each nested with one of the overburden wells. The bedrock wells will be the last well installed during the investigation at this

site. These wells will be installed adjacent to the overburden wells where the highest level of contamination is observed (i.e., visually and/or monitored). Three bedrock wells are necessary to define the direction of ground water flow in the bedrock to evaluate potential contaminant flow directions. Although an off-site upgradient well has already been installed near the site, its construction is such that its screen intercepts the bedrock and overburden material but not the ground water table. Given that this existing off-site well monitors multiple zones and that a sample of any floating organic contaminants (e.g., solvents), which are of concern at the site, can not be collected from the well, an additional upgradient off-site well is necessary. The locations of the existing monitoring wells and the planned monitoring wells are shown on Figure 10.

All of the wells, both previously existing and newly installed, will be sampled and analyzed for the full list of TCL parameters. The pH, specific conductance, and temperature of each ground water sample will be measured directly in the field immediately upon sample collection. Just prior to the ground water sampling, a ground water elevation measurement will be obtained from each well. Continuous ground water elevations will also be measured over a 72-hour period for two of the wells on the site (one overburden and one bedrock) and the one upgradient off-site overburden well. At the same time, continuous surface water elevation measurements will also be measured adjacent to the site in the bay. The continuous water elevation measurements will provide information on the bay's tidal effects on the site ground water flow characteristics. Water levels will be measured in each well a minimum of one time per month over a three-month period to provide some indication of seasonal ground water level fluctuations at the site.

4.5.2 Site 02 - Melville North Landfill

A total of five (5) monitoring wells will be installed to investigate the nature and extent of ground water contamination at the site. Four of the wells will be installed on the site and one of the wells will be installed upgradient and off of the site. No wells have previously been installed at the site. All wells will be installed in the overburden fill materials. The nature of the wastes disposed of at the landfill indicates that there is a need for investigating the ground water quality at the site.

The off-site well will provide background information on the water quality upgradient of the site. The locations of the planned monitoring wells are shown on Figure 17. All of the wells will be sampled and analyzed for the full list of TCL parameters. The pH, conductivity, and temperature of each ground water sample will be measured directly in the field immediately upon sample collection. Just prior to the ground water sampling, a ground water elevation measurement will be obtained from each well. Continuous ground water elevations will also be measured over a 72-hour period for two of the wells on the site and the one upgradient off-site well. At the same time continuous surface water elevation measurements will also be measured adjacent to the site in the bay. The continuous water elevation measurements will provide information on the bay's tidal effects on the site ground water flow characteristics. Water levels will be measured in each well a minimum of one time per month over a three-month period to provide some indication of seasonal ground water level fluctuations.

4.5.3 Site 09 - Old Fire Fighting Training Area

A total of five (5) monitoring wells will be installed to investigate the nature and extent of ground water contamination at the site. Four of the wells will be installed on the site and one of the wells will be installed upgradient and off of the site. No wells have been previously installed at the site; however, the results of a previous geotechnical investigation conducted on the site show that an oily substance exists on a portion of the site below the ground water table. Considering the previous site operations in which petroleum products were used, and the occurrence of those operations for nearly 30 years across the site, it is very likely that additional subsurface contamination exists across the site. This indicates that there is a need to investigate the ground water quality at the site.

The off-site well will provide background information on the ground water quality upgradient of the site. The locations of the planned monitoring wells are shown on Figure 24. All of the wells will be sampled and analyzed for the full list of TCL parameters. The pH, conductivity, and temperature of each ground water sample will be measured directly in the field immediately upon sample collection. Continuous ground water and bay water measurements will also be taken at the site similar to that planned for the two landfills, as is

discussed in Sections 4.4.1 and 4.4.2. Water levels will be measured in each well a minimum of one time per month over a three-month period to provide some indication of seasonal ground water level fluctuations.

4.5.4 Site 12 - Tank Farm Four

Eight (8) monitoring wells will be installed at five locations on the site to investigate ground water contamination at the site. Two previously installed wells are located at the western edge of the site which is in a direction somewhat downgradient of the underground storage tanks (USTs) at the site. The analytical results of the ground water samples from these wells indicate that metals and petroleum-based hydrocarbon contamination exist in the site ground water. Given that the well contamination is very likely attributed to the on-site USTs, the ground water at the site requires further investigation.

Five of the wells will be screened in the overburden material and three wells will be screened in the bedrock. Each bedrock well will be nested with one of the overburden wells. One bedrock well will be installed at one of those proposed well locations immediately downgradient of the USTs, which are the suspected ground water contamination sources. The other bedrock wells will be installed at those well locations where the highest levels of contamination are observed in the overburden well borings. Ground water monitoring and sampling from the bedrock wells will provide an indication of the direction of ground water flow and the presence of contamination in the bedrock aquifer. If the ground water table is not encountered in the overburden materials at a particular location, the well will be completed in the bedrock. The locations of the planned monitoring wells are shown on Figure 28. It is important to note that the planned well locations will be reevaluated based upon the soil gas survey results.

All of the wells will be sampled and analyzed for the full list of TCL parameters. The pH, conductivity, and temperature of each ground water sample will be measured directly in the field immediately upon collection. Just prior to the ground water sampling activities, a ground water elevation measurement will be obtained from each well. Water levels will be measured in each well a minimum of one time per month over a three-month period to provide some indication of seasonal ground water level fluctuations at the site.

4.5.5 Site 13 - Tank Farm Five

Monitoring wells will be installed at six locations to investigate the ground water contamination at the site. Ten monitoring wells were previously installed in the southwest portion of the site as part of a tank closure investigation for two of the USTs at the site. The results of that investigation indicate that ground water contamination exists in that limited area of the site. Given the existence of additional USTs, and a sludge burning pit at the site, it is likely that additional ground water contamination sources exists across the site. This indicates that the ground water across the site requires further investigation.

The planned well locations are shown on Figure 32. The previous well investigation data shows that ground water flow on a portion of the site appears to be in a northwest direction. The ground water flow at the site appears to be directly related to the site topography and influenced by the brook (Gomes Brook) which flows through the northern portion of the site into the bay. The planned well locations will be used to investigate the nature and extent of ground water contamination at the site and the effect of the brook on the site ground water. The previous well data also indicates that the ground water table at the site is within the bedrock. It is likely that this is the case across the site; however, the position of the ground water table is difficult to predict, given the variable topographic relief of the site.

Ground water samples will be collected from all of the six newly installed wells at the site and analyzed for the full list of TCL parameters and total petroleum hydrocarbons (TPHs). Ground water samples will also be collected from two of the other wells previously installed at the site (No. 86-1 and No. 86-3D) and analyzed for the full list of TCL parameters and TPHs. Samples will also be collected from the other eight wells previously installed at the site, but they will only be analyzed for TPHs and lead. The results from these analyses should provide a relative indication of ground water contamination present in these eight wells as compared to the other wells. The pH, conductivity, and temperature of each ground sample will also be measured directly in the field immediately upon collection.

Ground water elevation measurements will be taken at all of the wells. Just prior to the ground water sampling activities, a ground water elevation

measurement will be obtained from each well. Water levels will be measured in each well a minimum of one time per month over a three-month period. The information obtained from these measurements should provide some indication of seasonal ground water level fluctuations at the site.

- Well Boring, Drilling and Sampling Methods

The boreholes for the wells to be constructed in the unconsolidated overburden materials will be advanced to the desired depth using 4-inch minimum inside diameter (I.D.) hollow-stem augers. Split spoon samples will be collected continuously at 2.0-foot intervals from the well borings to a maximum depth of 20 feet or bedrock, whichever is encountered first. When it is necessary to extend well borings beyond 20 feet and bedrock is not encountered, split spoon samples will be collected at every 5-foot interval or identifiable change in strata. Standard penetration tests [ASTM D 1586-67 (1974)] will be conducted at every 2.0-foot sampling interval. The physical characteristics of each soil sample will be visually classified and described based upon the Unified Soil Classification System [ASTM D 2487]. As is possible, the soil samples to be submitted for analyses will be the same as those planned for each site's test borings. The type of well boring soil sample analyses will also be the same as those planned for each site's test boring soil samples. Shelby tube samples will also be collected according to ASTM Methods [ASTM D 1587-83] from three of the well borings completed on each of the two landfills. Each sample will be collected from the soil layer beneath the refuse material. The following tests will be applied to each Shelby tube sample: grain size, Atterberg limits, and permeability. The results obtained from these tests will assist in the assessment of contaminant migration potential. Soil samples to be submitted for laboratory analyses will be transferred from the split spoon to the sample container with a laboratory-cleaned dedicated stainless steel spoon. All split spoon samples will be monitored with an OVA and scintillation meter. All field observations will be recorded in a field notebook.

Bedrock wells are planned for the McAllister Point Landfill, the Old Fire Fighting Training Area, and Tank Farms Four and Five. Boreholes for the bedrock wells will be advanced to the bedrock surface using 4-inch minimum I.D. hollow-stem augers or steel casing. Split spoon samples will be collected continuously in each borehole to a depth of 20 feet or bedrock,

whichever is encountered first. If the bedrock surface is not encountered within 20 feet of the ground surface, the borehole will be advanced further by augering or driving casing, and split spoon samples will be collected every five feet. The borehole will be advanced into the bedrock with a double-tube Nx rock core barrel to the desired final depth. After coring is completed, the open borehole will be reamed out with a 4-inch minimum outside diameter (O.D.) tri-cone bit. Given that the integrity of the bedrock at one of the sites, Tank Farm Five, has been documented to be of poor quality, bedrock wells will be installed with well construction materials extended into the bedrock as opposed to leaving an open bedrock borehole.

The final depth of all monitoring wells will be determined by the TRC field geologist/engineer. Variables to be considered in establishing the wells' final depth will include: material encountered (e.g., refuse vs. clean material), observed contamination, geologic material, depth to water table, and site sampling objectives.

All well boring drill cuttings will be contained in labeled, DOT-approved 55-gallon drums at each well. At the conclusion of all investigations the drums will be transported to a designated drum staging area. The drum handling and storage details are provided in Section 4.5.3 of the project HASP.

All sampling equipment (i.e., augers, drilling rods, spoons) will be decontaminated prior to each use according to the procedures described in the project QA/QC Plan.

- Well Construction Details

The drilling and well construction activities will be subcontracted to a qualified well drilling firm. The on-site drilling activities will be conducted under the supervision of a TRC geologist/engineer.

Construction specifications which are common to all monitoring wells installed for this project include the following:

- 6- to 8-inch diameter borehole;
- 2-inch I.D. PVC riser and screen;
- Threaded or press joints only on PVC pipe (no glued joints);

- Silica (quartz) sand backfill to at least 1 foot above the top of the well screen;
- 2-foot minimum thick bentonite seal above the sand pack;
- Portland cement/bentonite slurry (approximately 6:1 ratio, respectively) in the well annulus from the top of the bentonite seal to the ground surface;
- All casing sealant and drilling fluids will be mixed with potable water;
- Vented well cap;
- Steel casing with a locking cap will be securely set in cement over the well casing stick up and a minimum of 3 feet below the ground surface. Wells will be clearly numbered on casing. (All wells at the Old Fire Fighting Training Area will be installed with curb boxes constructed at or below grade.); and
- Guard posts (3-inch minimum diameter) will be set at 120° spacing around the well (i.e., three per well). The posts will be set at least 3 feet above the ground surface and 2 feet below the ground surface into the well's cement apron.

Typical monitoring well construction details for the surficial overburden materials and bedrock wells are depicted in Figures 35 and 36, respectively. The driller and TRC geologist/engineer will maintain accurate written logs of the well construction details.

Well screen and riser lengths may vary for each well. Screen lengths for wells intercepting the water table will be a maximum 15 feet, with no more than five feet extending above the water table. The five-foot length of screen above the water table should ensure that the water table remains within the screened interval during seasonal and diurnal ground water fluctuations. A ten-foot screen length will be used for bedrock wells installed below the water table (e.g., Tank Farm Four). Well riser lengths will be field-determined so the top of the casing extends approximately one to two feet above the ground surface. A summary of the anticipated well construction details for all five of the sites is provided in Table 1.

- Well Development

Wells will be developed by the surge block technique. Fine-grained material around the well screen will be drawn into the well and removed by agitating the well water with a surge block and simultaneously pumping water

TABLE 1
ANTICIPATED WELL CONSTRUCTION DETAILS

Site	Number of Wells and Type	Estimated Well Completion Depth (feet below grade)	Estimated Screen Length (feet)
01 - McAllister Point Landfill	6 overburden wells 3 bedrock wells	15-40 30-55	10-20 ¹⁵ 10-15
02 - Melville North Landfill	5 overburden wells	50 ft 15-40 <u>25</u>	10-20
09 - Old Fire Fighting Training Area	5 overburden wells	50 ft 10-20 <u>20</u>	10-15
12 - Tank Farm Four	5 overburden wells 3 bedrock wells	25-35 35-50 <u>25</u>	10-20 10-15
13 - Tank Farm Five	6 bedrock wells	150 ft 40-50 <u>25</u>	15-20

Note: All wells will be constructed with 2-inch PVC well materials. Since the depth to bedrock and water are undetermined or approximated, the above well construction information may vary across a site.

from the well at a low discharge rate. A centrifugal pump outfitted with ASTM drinking water grade polyethylene tubing will be used for removing the water from the well. In order to prevent cross-contamination between the wells, the surge block will be decontaminated between each well. At a minimum, the surge block will be decontaminated with non-phosphate detergent and tap water, and rinsed with tap water and then deionized water. The polyethylene tubing will also be replaced between each well. The dedicated tubing will be rinsed with deionized water prior to its use. All water produced during well development will be contained in 55-gallon drums.

Should the depth to ground water prohibit the use of the surge block and pumping technique, an alternative method will be used to develop the well. A suitable pumping device (e.g., air-lift system, Waterra™ hand pump) will be installed in the well. All equipment inserted into the well for developing will be either dedicated to that well, or, at a minimum, first washed with non-phosphate detergent and tap water, and rinsed with tap water and then deionized water.

- Well Permeability Testing

After the completion and development of the wells, a permeability test will be performed at several of the wells at each site. A brief description of the test methods to be employed are presented in Table 2. The particular permeability test procedure used at a well will depend upon the expected aquifer permeability and location of the water table with respect to the well screen. All permeability testing data will be recorded in a field notebook. The permeability test data should better define the site aquifer characteristics for use in evaluating the ground water conditions at each site.

- Ground Water Sampling

Ground water samples will be collected from all of the newly installed monitoring wells and the previously existing wells at each site. On the day of sampling, the water level in each well will be measured to the nearest hundredth of a foot with an electronic water sensing device (Slope Indicator). The water level indicator will be decontaminated with deionized water prior to each use unless visual observations indicate additional decontamination is necessary. All water level measurements will be recorded in a field notebook.

TABLE 2
PERMEABILITY TEST METHODS

MATERIAL	TEST	REFERENCE
Medium to high permeability (clean sand and gravel), screen below or partially above the water table	Pump/recovery test with gasoline-powered pump	Determining the Permeability of Water Table Aquifers. The Recovery method for determining the Coefficient of Transmissibility (USGS Water-Supply Paper 1536-I).
Low permeability (silt and silty sand), entire screen below water table	Slug injection/extraction test	The Slug-Injection Test for Estimating the Coefficient of Transmissibility of an Aquifer (USGS Water-Supply Paper 1536-I).
Low permeability (silt and silty sand), screen partially above water table	Pump with low-discharge battery-powered pump	Determining the Permeability of Water Table Aquifers. The Recovery Method for determining the Coefficient of Transmissibility (USGS Water-Supply Paper 1536-I).
Extremely low permeability (clay), screen below or partially above the water table	Slug injection and extraction test	The Slug-Injection Test for Estimating the Coefficient of Transmissibility of an Aquifer (USGS Water-Supply Paper 1536-I).

Prior to ground water sampling, a minimum of three well volumes will be purged from each well; however, this amount may not be practical in wells with very slow recoveries. In these instances, and if site conditions warrant, the well may be evacuated to near dryness and allowed to recover to a volume sufficient for sampling. Evacuation rates must be kept below five gallons/minute to avoid over-pumping or pumping the well to dryness (ideally, wells should never be pumped to dryness). To accomplish this, pumping rates may be adjusted, sometimes to less than one gallon/minute, and pumping times extended in order to remove the required three well volumes. The well will then be sampled within two hours of evacuation to assure a representative ground water sample is collected from the aquifer. Because of the small diameter of the wells and the expected variability in aquifer transmissivities, a low volume peristaltic pump will be used for well purging. Dedicated pump tubing will be used at each well. In instances where the depth to water precludes the use of a peristaltic pump, wells will be purged with a dedicated, hand-operated bailer. The purged well water will be contained in 55-gallon drums.

All ground water samples will be collected with dedicated Teflon® bailers. The ground water sampling protocol will be according to procedures described in Method III-9, provided in Appendix A, as adopted from EPA's Site Characterization Methods Manual (EPA, 1984). The teflon bailers, stainless steel cables, and attachment hardware will be laboratory-cleaned using the decontamination procedure outlined in the QA/QC plan.

Determination of pH, specific conductance, and temperature of the ground water samples will occur in the field immediately after sample collection. The pH will be measured to the nearest tenth of a standard unit using an Orion Model 407A Ion-specific meter or equivalent. Specific conductance will be measured with a YSI conductivity meter or equivalent. All field measurements will be recorded in a field notebook.

- Well Sample Designation

All ground water and well boring soil samples will be assigned a designated field identification number which will reference the site name, sample type, sample location number, and sample date. Below are examples of the planned well ground water and well boring soil sample designation scheme:

Ground Water Samples:

Example: TF5-MW1-61089

where: TF5 = Tank Farm Five
MW = Monitoring Well Water Sample
1 = Well Number
60589 = Sample Date

Well Boring Soil Samples:

Example: TF5-M12-51789

where: TF5 = Tank Farm Five
M = Well Boring Soil Sample
1 = Well Number
2 = Sampling Interval
51789 = Sample Date

4.6 Tanks and Structures

Samples will be collected from structures and tanks located at the two tank farm sites. The information from the sample analyses will aid in characterizing the contents of the structures and determining if they are a source of contamination at the site.

• Tank and Structure Sampling Strategy and Locations

Limited sampling of the tanks has occurred at both of the tank farm sites. The results of the previous sampling were used in establishing the planned tank sampling scheme for each site. No sampling has been conducted of the oil/water separator or burning pit present at the tank farms. The specific tank and structure sampling scheme for each site is presented below.

4.6.1 Site 12 - Tank Farm Four

Samples will be collected from each of the USTs at the site. In a previous site investigation, water samples were collected from six of the twelve USTs at the site. The analytical results of these samples document that the water in the tanks is contaminated with petroleum-based hydrocarbons. Given that the USTs are a possible source of subsurface contamination at the site and that the UST's contents must be characterized to properly evaluate the UST's closure alternatives, the contents of each tank will be physically evaluated and sampled.

It is known that during the operation of the tank farm, all of the USTs at this site contained either fuel oil or diesel. When the tank farm ceased to operate all of the tanks were filled with water which served as ballast to keep the tanks from rising out of the ground. The interior of the USTs were not cleaned and, thus, residues (e.g., bottom sludge and oil) remaining in each UST was not removed prior to filling the tanks with water. As is documented for most of the USTs at Tank Farm Five, this practice results in a multi-layered media in the UST, consisting of a bottom sludge layer, middle water layer, and a floating oil layer. The depth and quantity of each layer will be determined for each UST at this site. If sufficient amount of each layer is present in an UST, it will be sampled for laboratory analyses. The sludge samples will be analyzed for EP Toxicity characteristics and the full list of TCL parameters (less pesticides). The water samples will be analyzed for the TCL semi-volatile organic compounds, volatile organic compounds, and inorganic compounds. The oil samples will be analyzed for the full list of TCL parameters (less pesticides).

Soil and/or waste samples will also be collected from the oil/water (o/w) separator located on the site. The location of the o/w separator is shown on the site map on Figure 4. The o/w separator is a four-walled concrete structure which, according to design drawings, has a concrete bottom. Previous site planning maps and design drawings tend to indicate that the o/w separator was once used as a burning pit. A 1959 base planning map indicates that a "burning chamber" existed at the location of the now present o/w separator. The o/w separator design drawings also show a pre-existing structure at the location, which was very similar to the burning pit at Tank Farm Five. The o/w separator appears to have been constructed within a portion of the burning pit. The dimensions of the initial structure, hereafter referred to as a burning pit, were approximately 20 feet wide by 40 feet long by 12 feet deep. According to the design drawings, the o/w separator is L-shaped and consists of three separate compartments within a portion of the old burning pit. The dimensions of the o/w separator are approximately 20 feet by 20 feet along its two longest sides. Given the two apparent uses of the structure, samples will be collected from within both the o/w separator area and the outside burning pit area. A portable, split spoon, tripod derrick rig will be used over the structure to collect split spoon

samples from borings at two locations in the burning pit area. The o/w separator design drawings also indicate that the burning pit area was filled in with approximately 7 feet of gravel; however, it is not known if this is actually the case or whether any previous waste still exists in the area. Continuous split spoon sludge and/or soil sampling will be conducted at 2.0-foot intervals in the borings to the bottom of the structure. A maximum of one sample will be collected for analyses from each boring. If contamination is observed at a particular depth in a boring, a sample will be collected from that location for analyses. If no contamination is observed in a boring, a sample will be collected at the bottom of the structure; however, if the structure does not have a bottom, a sample will be collected from 2.0 feet beneath the surface or gravel fill layer (if present) to confirm the suspected absence of contamination. Samples will also be collected from two locations in the o/w separator area. If measurable amounts oil, water, and/or sludge are present in the o/w separator, the amount of each media will be measured and composite samples of each collected for analyses. All of the samples will be analyzed for the full list of TCL parameters (less pesticides). All samples collected from the burning pit area will also be archived for possible dioxin and furan analyses. The sample analyses results will be reviewed to determine if dioxin and furan analyses are appropriate for any of the samples based upon the detected TCL compounds.

4.6.2 Site 13 - Tank Farm Five

Samples will be collected from each of the USTs at the site. It is known that during the operation of the tank farm, all of the USTs at this site either contained fuel oil or diesel. More recently, two of the USTs were used to store waste oil. In a previous tank closure investigation at the site, the contents of all of the eleven USTs at the site were physically characterized and sampled. Water samples were collected from each of the USTs and analyzed for priority pollutant metals, volatile organic compounds (VOCs), and several other miscellaneous parameters (e.g., pH, BOD). Several metals were detected in all of the UST water samples and VOCs were detected in eight of the eleven UST water samples. Sludge and oil samples were also collected from the two of the USTs (Nos. 53 and 56) for which the previously-mentioned tank closure investigation was conducted. The oil samples from these two tanks were analyzed for priority pollutant metals, VOCs, SVOCs, pesticides, PCBs, and

other miscellaneous parameters (e.g., BOD, BTU value, % sulfur). Metals, VOCs, and SVOCs were detected in both UST oil samples. The sludge samples were analyzed for eight metals, percent volatile solids, and several other miscellaneous parameters (e.g., % solids, % silica). Metals and volatile solids were detected in both of the sludge samples. Ground water monitoring wells were also installed around the two USTs and sampled. The analytical results of ground water samples from these wells document that the USTs have contaminated the area ground water with metals and VOCs. The above results indicate that the contents of all of the USTs must be fully investigated as possible sources of subsurface contamination at the site. The contents of the USTs must also be characterized to properly evaluate the closure alternatives for the tanks.

As is the case with Tank Farm Four, all of the USTs at this site were filled with water when they were decommissioned. The USTs at this site were also not cleaned prior to being filled with water. A multi-layered media consisting of sludge, water, and/or oil was found in all of the USTs, as is documented in the previously mentioned tank closure investigation results. Although the types and amounts of media in each UST, except one (No. 57), was measured during the site tank closure investigation, the amounts will be verified during this investigation. The new UST content measurements may indicate whether a tank is leaking and at what rate when compared with the previous measurements. If a sufficient amount of each media is present in an UST, it will be sampled for laboratory analyses. The sludge samples will be analyzed for EP Toxicity characteristics and the full list of TCL parameters (less pesticides). The water samples will be analyzed for the TCL semi-volatile organic compounds, volatile organic compounds, and inorganic compounds. The oil samples will be analyzed for the full list of TCL parameters (less pesticides).

Waste and/or soil samples will also be collected from the sludge burning pit located on the site. The location of the burning pit is shown on the site map on Figure 5. Based on its design drawings, the size of the burning pit is approximately 6 feet high by 40 feet wide by 45 feet long. The burning pit is a four-walled concrete structure. The design drawings indicate that the pit's bottom consists of approximately two feet of sand and gravel, underlain by

concrete; however, previous reports stated that the pit had only a sand bottom. A portable, split spoon, tripod derrick rig will be used within the burning pit to collect split spoon samples from two borings. Continuous split spoon sampling will be conducted at 2.0-foot intervals in the borings to just beyond all observed signs of contamination. If sludge is present in the pit, one composite sludge sample will be collected at the two boring locations. A maximum of three soil samples will be collected from each boring; one from the first sample interval (0 to 2.0 feet), and one from the sample interval at the bottom of the observed contamination, and one from the sample interval completed just beyond all signs of contamination. If the ground water table is present in the observed contamination, the second sample will be collected at the ground water table. If the burning pit is found to have a concrete bottom, one composite sludge sample will be collected from each of the two borings. All of the burning pit samples will be analyzed for the full list of TCL parameters (less pesticides). The samples will also be archived for possible dioxin and furan analyses. The sample analyses results will be reviewed to determine if dioxin and furan analyses are appropriate for any of the samples based upon the detected TCL compounds. If the burning pit is found to be an oil/water separator built within a burning pit, as appears to be the case at Tank Farm Four, the same sampling and analyses scheme planned for Tank Farm Four will be used in this structure.

- Tank/Structure Sampling Methods

Tank sampling will include the collection of samples from three different media, oil, water and sludge. Floating oil samples will be collected from each tank with a pond sampler according to procedures described in Method III-2, provided in Appendix A, as adopted from EPA's Site Characterization Methods Manual (EPA, 1984). Water samples will be collected with a Kemmerer bottle, or equivalent, according to procedures described in Method III-4 (EPA, 1984), provided in Appendix A. To prevent contamination of the water sampling device as it passes through the floating oil layer, a section of pipe casing (with a closed lower end consisting of a spring-loaded flap, or equivalent) will first be lowered through the oil layer to the desired water sampling depth then the water sampling device will lower down the casing past the flap and a water sample collected. Sludge samples will be collected with a gravity corer according to procedures described in Method II-5 (EPA, 1984), provided

in Appendix A. If this method is not successful in retrieving a sludge sample, a petit ponar sampler will be used and the sampling procedures will be conducted according to Method II-6 (EPA, 1984), provided in Appendix A. All tank sampling equipment will be decontaminated between each use according to the equipment decontamination procedure described in the project QA/QC plan.

Oil/water separator and burning pit sample media are expected to consist of oil, water, and/or sludge. If a floating oil layer is present on water in either structure, oil and water samples will be collected with a pond sampler and Kemmerer sampler, respectively, according to the procedures described above. If there is no floating oil layer on the water, the water samples will be collected with a pond sampler as described above. If possible (i.e., sample within reach) water samples will be collected directly in the sample container. Sludge samples will be collected from the oil/water separator with a gravity corer or petit ponar dredge according to the procedures specified above. If possible (i.e., available and safe access to the bottom of separator), a hand auger will be used to collect sludge samples according to the procedures described in Method II-4 (EPA, 1984), provided in Appendix A. Sludge samples in the burning pit will be collected with a portable, split spoon tripod derrick rig at 2.0-foot intervals.

4.7 Land Surveying

Upon the completion of all field sampling activities at all five sites, the sites will be surveyed by a State of Rhode Island registered surveyor. The location and elevation of all sampling stations will be determined in the survey. Completed wells will be surveyed for elevation of the top of the protective casing, top of the well casing and the adjacent land surface. All locations will be referenced to a United States Geological Survey benchmark.

TABLE 3
NETC-NEWPORT
SUMMARY OF FIELD INVESTIGATION PROGRAM

SITE	ACTIVITY	SCOPE	NUMBER OF SAMPLES	SAMPLE ANALYSES
01 - McAllister Point Landfill	Geophysical Survey	50' spaced traverse	N/A	N/A
	Surface Soil Sampling	17 locations	17 samples	TCL plus archive dioxin ⁽¹⁾
	Test Borings	10 borings	2-3 samples/boring	TCL, archive dioxin ⁽¹⁾ , TCLP ⁽⁴⁾
	Monitoring Wells	9 wells	1 per well plus 3 existing wells	TCL
	Surface Water Sampling	2 leachate springs	1 per spring	TCL
	Sediment Sampling	20 locations	2 per location	TCL volatiles, semi-volatile, inorganics, PCBs
	Biota Sampling	20 locations	1 per location	TCL semi-volatile, inorganics, PCBs
02 - Melville North Landfill	Geophysical Survey	50' spaced traverse	N/A	N/A
	Surface Soil Sampling	15 locations	15 samples	TCL plus archive dioxin ⁽¹⁾
	Test Pits	Field-determined	2 soil and 2 sludge	TCL, archive dioxin ⁽¹⁾ , TCLP
	Test Borings	10 borings	2-3 samples/boring	TCL, archive dioxin ⁽¹⁾ , TCLP ⁽⁴⁾
	Monitoring Wells	5 wells	1 water sample per well; 2-3 soil samples/boring	TCL; TCL, archive dioxin ⁽¹⁾ , TCLP ⁽⁴⁾
	Sediment Sampling	10 locations (3 on-site)	1 per location	TCL volatiles, semi-volatiles, inorganics, PCBs
	Biota Sampling	7 locations	1 per location	TCL semi-volatile, inorganics, PCBs
09 - Old Fire Fighting Training Area	Geophysical Survey	50' spaced traverse	N/A	N/A
	Soil Gas Survey	100' site grid	48 points	VOCs
	Surface Soil Sampling	6 locations	6 samples	TCL plus archive dioxin ⁽¹⁾
	Test Borings	7 borings	1-2 samples/boring	TCL, archive dioxin ⁽¹⁾ , TPH ⁽⁵⁾
	Monitoring Wells	5 Wells	1 water sample per well 1-2 soil samples/boring	TCL TCL, archive dioxin ⁽¹⁾ , TPH ⁽⁵⁾
	Sediment Sampling	8 locations	1 per location	TCL volatiles, semi-volatiles, inorganics, PCBs
	Biota Sampling	8 locations	1 per location	TCL semi-volatiles, inorganics, PCBs

TABLE 3
NETC-NEWPORT
SUMMARY OF FIELD INVESTIGATION PROGRAM
(Continued)

SITE	ACTIVITY	SCOPE	NUMBER OF SAMPLES	SAMPLE ANALYSES
12 - Tank Farm Four	Soil Gas Survey	400' site grid and 4 per tank area	Approx. 80 points	VOCs
	Surface Soil Sampling	1-2 per tank area/ 1 per tank area ⁽²⁾	30/18 ⁽²⁾ samples	TPH, lead/TCL pesticides, PCB ⁽²⁾ ⁽³⁾
	Monitoring Wells	8 wells	1 water sample per well; 1-2 soil samples/boring	TCL; TCL, archive dioxin ⁽¹⁾ , TPH ⁽⁵⁾
	Surface Water Sampling	3 locations	1 per location	TCL (less pesticides/PCBs)
	Sediment Sampling	6 locations	2 per location	TCL (less pesticides)
	Tank and Structure Sampling	12 tanks and 1 structure	1-3 per location	EP Toxicity, (less pesticides) ⁽¹⁾ TCL volatile, semi-volatile, inorganics ⁽⁷⁾ TCL (less pesticides/PCBs) ⁽⁸⁾ TCL (less pesticides), archive dioxin ⁽¹⁾ ⁽⁹⁾
13 - Tank Farm Five	Soil Gas Survey	400' site grid and 4 per tank area	Approx. 65 points	VOCs
	Surface Soil Sampling	1-2 per tank area/ 1 per tank area ⁽²⁾	30/18 ⁽²⁾ samples	TPH, lead/TCL pesticides, PCB ⁽²⁾ ⁽³⁾
	Monitoring Wells	6 wells	1 water sample per well and 2 existing wells; 8 existing wells; 1-2 soil samples/boring	TCL; TPH, lead TCL, archive dioxin ⁽¹⁾ , TPH ⁽⁵⁾
	Surface Water Sampling	5 locations	1 per location	TPH, Lead
	Sediment Sampling	5 locations	1 per location	TPH, Lead PCBs
	Tank and Structure Sampling	11 tanks and 1 structure	1-3 per location	EP Toxicity, TCL (less pesticides) ⁽⁷⁾ TCL volatile, semi-volatile, inorganics ⁽⁷⁾ TCL (less pesticides/PCBs) ⁽⁸⁾ TCL (less pesticides), archive dioxin ⁽¹⁾ ⁽⁹⁾

NOTES:

- (1) Samples archived for dioxin and furan analyses.
- (2) Phased investigation, first phase/second phase.
- (3) One sample analyzed for pesticides/PCBs.
- (4) TCLP analysis of approximately 50% of fill samples.
- (5) TPH analysis if no contamination observed in boring.
- (6) Sludge fraction analyses.
- (7) Water fraction analyses.
- (8) Oil fraction analyses.
- (9) Structure soil/waste samples.

5.0 SCHEDULE

The anticipated schedule for the RI/FS is provided on Figure 37. A more detailed schedule for the field activities will be prepared when TRC develops the RI/FS cost estimate.

6.0 REFERENCES

- Envirodyne Engineers, Inc., 1983. Initial Assessment Study Naval Education and Training Center, Newport, RI, prepared for the Navy.
- Environmental Resource Associates, Inc., 1987. Tank Closure Plan for Tanks 53 and 56, Tank Farm 5, Naval Education and Training Center, Newport, RI, prepared for the Navy.
- Loureiro Engineering Associates, 1986. Confirmation Study Report, Naval Education and Training Center, Newport, RI, prepared for the Navy.
- U.S. EPA, 1984. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition, EPA-600/4-84-076, December 1984.
- U.S. EPA, 1987. A Compendium of Superfund Field Operations Methods: Volumes I and II. EPA/540/P-87/001b, August 1987.
- U.S. EPA, 1988. Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA, OSWER Directive 9335.3-01, Draft - March 1988.

APPENDIX A
SAMPLING METHODS

2.2.1 METHOD II-1: SOIL SAMPLING WITH A SPADE AND SCOOP

Discussion

The simplest, most direct method of collecting soil samples for subsequent analysis is with the use of a spade and scoop. A normal lawn or garden spade can be utilized to remove the top cover of soil to the required depth and then a smaller stainless steel scoop can be used to collect the sample.

Uses

This method can be used in most soil types but is limited somewhat to sampling the near surface. Samples from depths greater than 50 cm become extremely labor intensive in most soil types. Very accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the technician. The use of a flat, pointed mason trowel to cut a block of the desired soil will be of aid when undisturbed profiles are required. A stainless steel scoop or lab spoon will suffice in most other applications. Care should be exercised to avoid the use of devices plated with chrome or other materials. Plating is particularly common with garden implements such as potting trowels.

Procedures for Use

1. Carefully remove the top layer of soil to the desired sample depth with a precleaned spade.
2. Using a precleaned stainless steel scoop or trowel, remove and discard a thin layer of soil from the area which comes in contact with the shovel.
3. Transfer sample into an appropriate sample bottle with a stainless steel lab spoon or equivalent.
4. Check that a Teflon liner is present in the cap if required. Secure the cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach supplemented by a minimal holding time. For specific containerization and preservation requirements consult Appendix A.
5. Label the sample bottle with the appropriate sample tag. Be sure to label the tag carefully and clearly, addressing all the categories or parameters. Complete all chain-of-custody documents and record in the field log book.
6. Decontaminate equipment after use and between sample locations. For specific decontamination guidelines, consult Appendix E.

2.2.2 METHOD II-2: SUBSURFACE SOLID SAMPLING WITH AUGER
AND THIN-WALL TUBE SAMPLER

Discussion

This system consists of an auger bit, a series of drill rods, a "T" handle, and a thin-wall tube corer (see Figure 2-1). The auger bit is used to bore a hole to the desired sampling depth and then withdrawn. The auger tip is then replaced with the tube corer, lowered down the borehole, and forced into the soil at the completion depth. The corer is then withdrawn and the sample collected.

Alternately the sample can be recovered directly from the auger. This technique however, does not provide an "undisturbed" sample as would be collected with a thin tube sampler. In situations where the soil is rocky, it may not be possible to force a thin tube sampler through the soil or sample recovery may be poor. Sampling directly from the auger may be the only viable method. Several auger types are available which include Bucket type, continuous flight (screw) and posthole augers. Bucket types are good for direct sample recovery and are fast and provide a large volume of sample. When continuous flight (screw) augers are utilized, the sample can be collected directly off the flights, however, this technique will provide a somewhat unrepresentative sample as the exact sample depth will not be known. The continuous flights auger are, however, satisfactory for use when a composite of the entire soil column is desired. Posthole augers have limited utility for sample acquisition as they are designed more for their ability to cut through fibrous, heavily rooted, swampy areas. In soils where the borehole will not remain open when the tool is removed, a temporary casing can be used until the desired sampling depth is reached.

Uses

This system can be used in a wide variety of soil conditions. It can be used to sample both from the surface, by simply driving the corer without preliminary boring, or to depths in excess of 6 meters. The presence of rock layers and the collapse of the borehole, however, usually prohibit sampling at depths in excess of 2 meters. Interchangeable cutting tips on the corer reduce the disturbance to the soil during sampling and aid in maintaining the core in the device during removal from the borehole.

Procedures for Use

1. Attach the auger bit to a drill rod extension and further attach the "T" handle to the drill rod.
2. Clear the area to be sampled of any surface debris (twigs, rocks, litter). It may be advisable to remove the first 8 to 15 cm of surface soil for an area approximately 15 cm in radius around the drilling location.

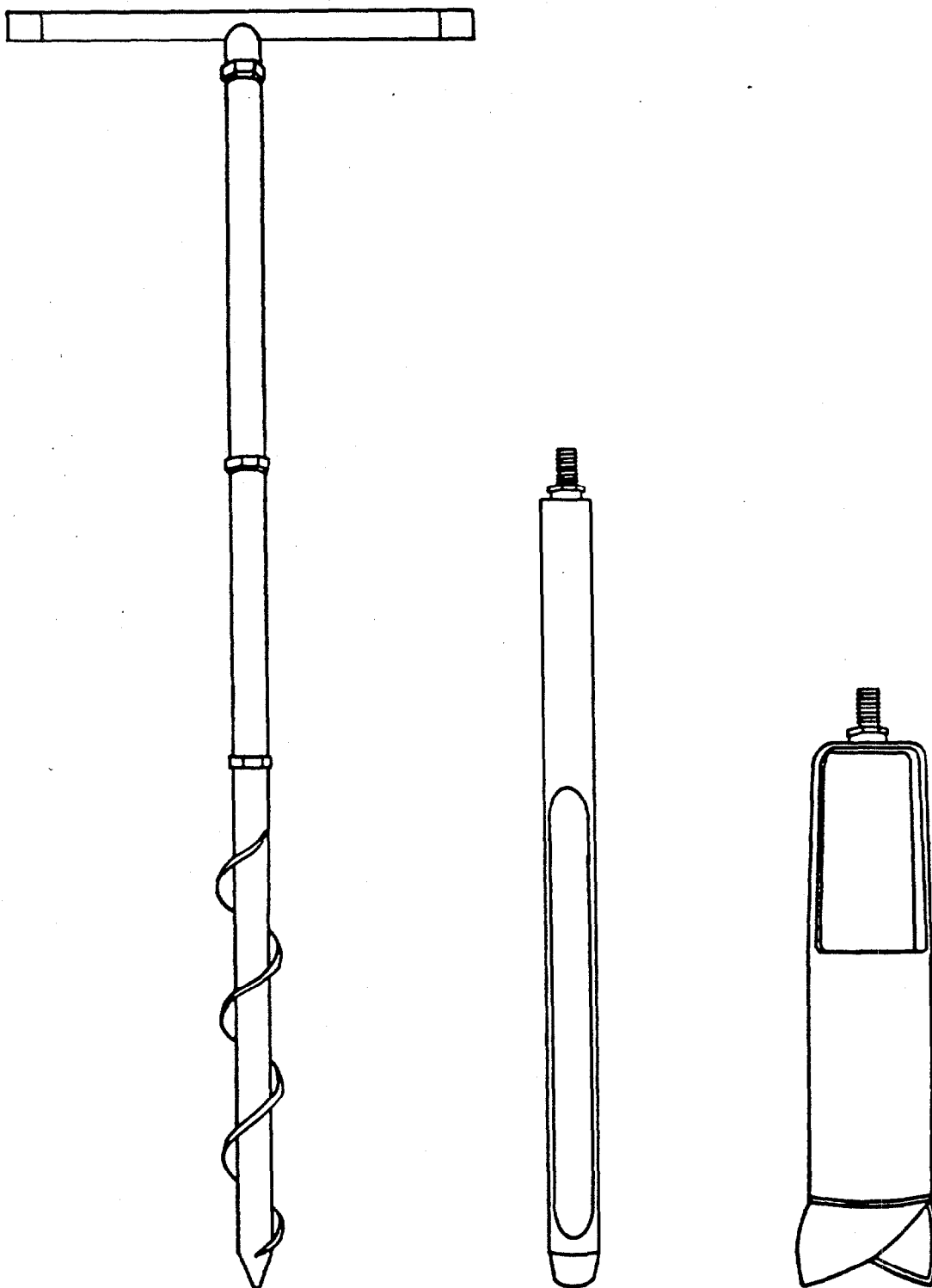


Figure 2-1. Augers and thin-wall tube sampler.

3. Begin drilling, periodically removing accumulated soils. This prevents accidentally brushing loose material back down the borehole when removing the auger or adding drill rods.
4. After reaching desired depth, slowly and carefully remove auger from boring. (Note: When sampling directly from auger, collect sample after auger is removed from boring and proceed to Step 10.)
5. Remove auger tip from drill rods and replace with a precleaned thin-wall tube sampler. Install proper cutting tip.
6. Carefully lower corer down borehole. Gradually force corer into soil. Care should be taken to avoid scraping the borehole sides. Hammering of the drill rods to facilitate coring should be avoided as the vibrations may cause the boring walls to collapse.
7. Remove corer and unscrew drill rods.
8. Remove cutting tip and remove core from device.
9. Discard top of core (approximately 2.5 cm), which represents any material collected by the corer before penetration of the layer in question. Place remaining core into sample container.
10. Check that a Teflon liner is present in the cap if required. Secure the cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach supplemented by a minimal holding time. Consult Appendix A for containerization and preservation recommendations.
11. Label the sample bottle with the appropriate sample tag. Be sure to label the tag carefully and clearly, addressing all the categories or parameters. Complete all chain-of-custody documents and record in the field logbook.
12. Decontaminate sampling equipment after use and between sampling locations. Refer to Appendix E for decontamination requirements.

Sources

deVera, E. R., Simmons, B. P., Stephens, R. D., and Storm, D. L. "Samplers and Sampling Procedures for Hazardous Waste Streams." EPA 600/2-80-018, January 1980.

2.3.2 METHOD II-4: SAMPLING SLUDGE OR SEDIMENTS WITH A HAND CORER

Discussion

This device is essentially the same type of thin-wall corer described for collecting soil samples (Method II-2). It is modified by the addition of a handle to facilitate driving the corer (see Figure 2-2) and a check valve on top to prevent washout during retrieval through an overlying water layer.

Uses

Hand corers are applicable to the same situations and materials as the scoop described in Method II-3. It has the advantage of collecting an undisturbed sample which can profile any stratification in the sample as a result of changes in the deposition.

Some hand corers can be fitted with extension handles which will allow the collection of samples underlying a shallow layer of liquid. Most corers can also be adapted to hold liners generally available in brass, polycarbonate plastic or Teflon. Care should be taken to choose a material which will not compromise the intended analytical procedures.

Procedures for Use

1. Inspect the corer for proper precleaning, and select sample location.
2. Force corer in with smooth continuous motion.
3. Twist corer then withdraw in a single smooth motion.
4. Remove nosepiece and withdraw sample into a stainless steel or Teflon tray.
5. Transfer sample into an appropriate sample bottle with a stainless steel lab spoon or equivalent.
6. Check that a Teflon liner is present in cap if required. Secure the cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach supplemented by a minimal holding time. Appendix A, Sample Containerization and Preservation should be consulted for specific requirements.
7. Label the sample bottle with the appropriate sample tag. Be sure to label the tag carefully and clearly, addressing all the categories or parameters. Complete all chain-of-custody documents and record in the field logbook.
8. Decontaminate sampling equipment after use and between sample locations as required by procedures in Appendix E, Decontamination.

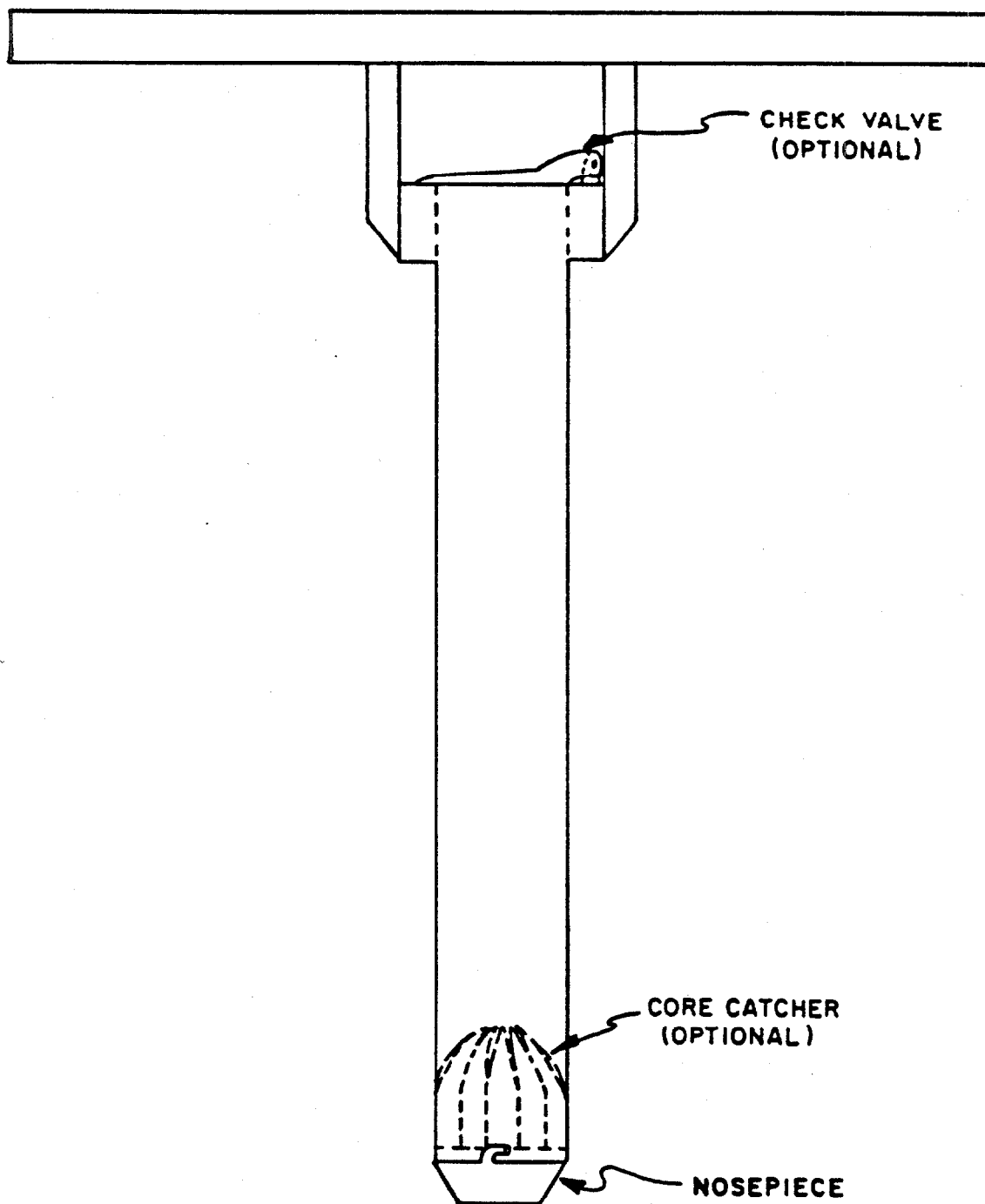


Figure 2-2. Hand corer.

2.3.3 METHOD II-5: SAMPLING BOTTOM SLUDGES OR SEDIMENTS WITH A GRAVITY CORER

Discussion

A gravity corer is a metal tube with a replacement tapered nosepiece on the bottom and a ball or other type of check valve on the top. The check valve allows water to pass through the corer on descent but prevents a washout during recovery. The tapered nosepiece facilitates cutting and reduces core disturbance during penetration.

Most corers are constructed of brass or steel and many can accept plastic liners and additional weights (see Figure 2-3).

Uses

Corers are capable of collecting samples of most sludges and sediments. They collect essentially undisturbed samples which represent the profile of strata which may develop in sediments and sludges during variations in the deposition process. Depending on the density of the substrate and the weight of the corer, penetration to depths of 75 cm (30 inches) can be attained.

Care should be exercised when using gravity corers in vessels or lagoons that have liners because penetration depths could exceed that of the substrate and result in damage to the liner material.

Procedures for Use

1. Attach a precleaned corer to the required length of sample line. Solid braided 5 mm (3/16 inch) nylon line is sufficient; 20 mm (3/4 inch) nylon, however, is easier to grasp during hand hoisting.
2. Secure the free end of the line to a fixed support to prevent accidental loss of the corer.
3. Allow corer to free fall through liquid to bottom.
4. Retrieve corer with a smooth, continuous lifting motion. Do not bump corer as this may result in some sample loss.
5. Remove nosepiece from corer and slide sample out of corer into stainless steel or Teflon pan.
6. Transfer sample into appropriate sample bottle with a stainless steel lab spoon or equivalent.
7. Check that a Teflon liner is present in cap if required. Secure the cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach supplemented by a minimal holding time. Refer to Appendix A for sample containerization and preservation guidelines.

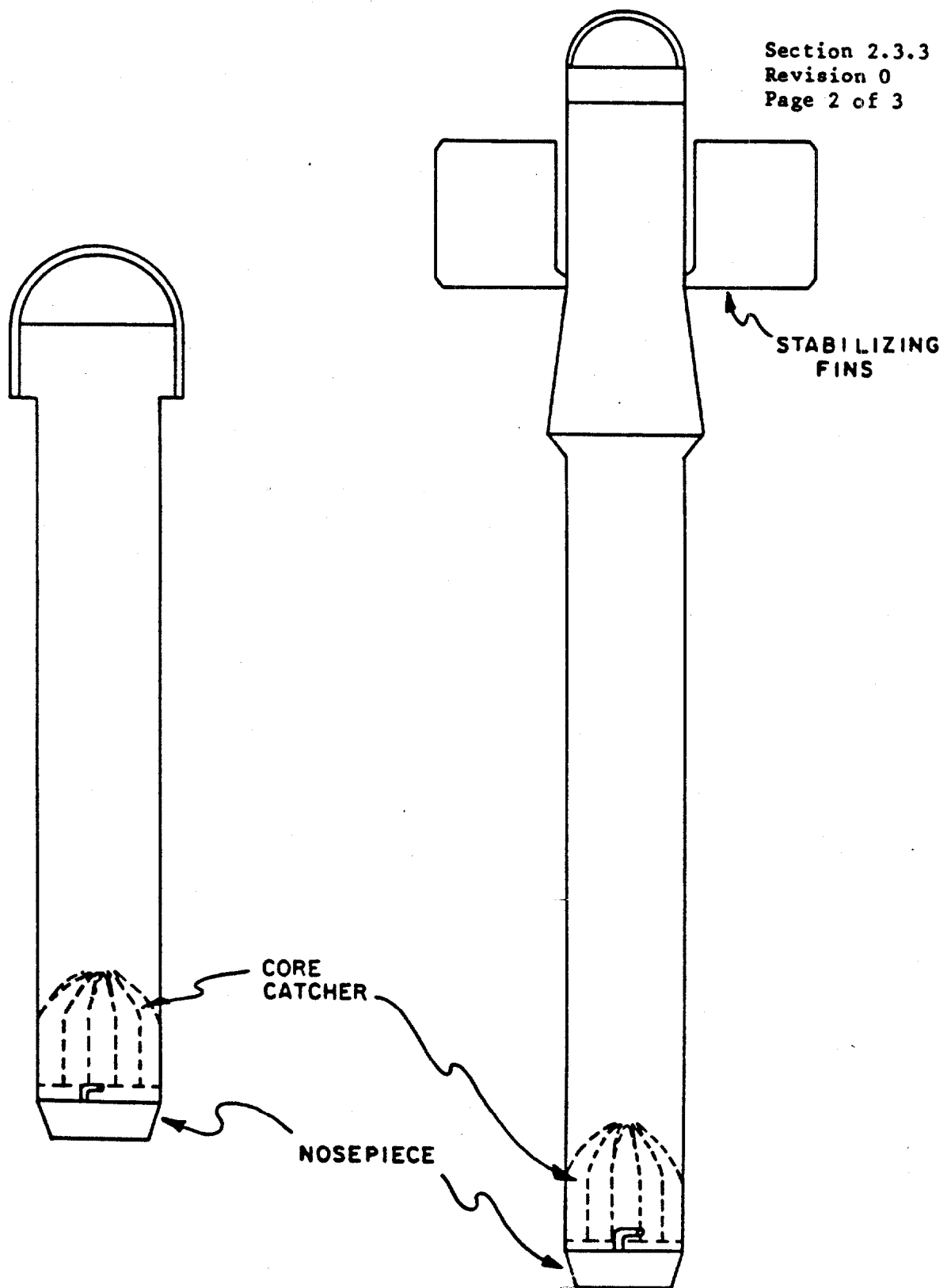


Figure 2-3. Gravity corers.

8. Label the sample bottle with the appropriate sample tag. Be sure to label the tag carefully and clearly, addressing all the categories or parameters. Complete all chain-of-custody documents and record in the field logbook.
9. Consult Appendix E for decontamination requirements and decontaminate sampling equipment after use and between sampling locations.

Sources

American Public Health Association. "Standard Methods for the Examination of Water and Wastewater" 14th Edition, Washington, D.C. 1975.

2.3.4 METHOD II-6: SAMPLING BOTTOM SLUDGES OR SEDIMENTS WITH A PONAR GRAB

Discussion

The Ponar grab is a clamshell type scoop activated by a counter lever system. The shell is opened and latched in place and slowly lowered to the bottom. When tension is released on the lowering cable the latch releases and the lifting action of the cable on the lever system closes the clamshell (see Figure 2-4).

Uses

Ponars are capable of sampling most types of sludges and sediments from silts to granular materials. They are available in a "Petite" version with a 232 square centimeter sample area that is light enough to be operated without a winch or crane. Penetration depths will usually not exceed several centimeters. Grab samplers, unlike the corers described in Method II-5, are not capable of collecting undisturbed samples. As a result, material in the first centimeter of sludge cannot be separated from that at lower depths. The sampling action of these devices causes agitation currents which may temporarily resuspend some settled solids. This disturbance can be minimized by slowly lowering the sampler the last half meter and allowing a very slow contact with the bottom. It is advisable, however, to only collect sludge or sediment samples after all overlying water samples have been obtained.

Procedures for Use

1. Attach a precleaned Ponar to the necessary length of sample line. Solid braided 5 mm (3/16 inch) nylon line is usually of sufficient strength; however, 20 mm (3/4 inch) or greater nylon line allows for easier hand hoisting.
2. Measure and mark the distance to bottom on the sample line. A secondary mark, 1 meter shallower, will indicate proximity so that lowering rate can be reduced, thus preventing unnecessary bottom disturbance.
3. Open sampler jaws until latched. From this point on, support sampler by its lift line or the sampler will be tripped and the jaws will close.
4. Tie free end of sample line to fixed support to prevent accidental loss of sampler.
5. Begin lowering the sampler until the proximity mark is reached.
6. Slow rate of descent through last meter until contact is felt.
7. Allow sample line to slack several centimeters. In strong currents more slack may be necessary to release mechanism.

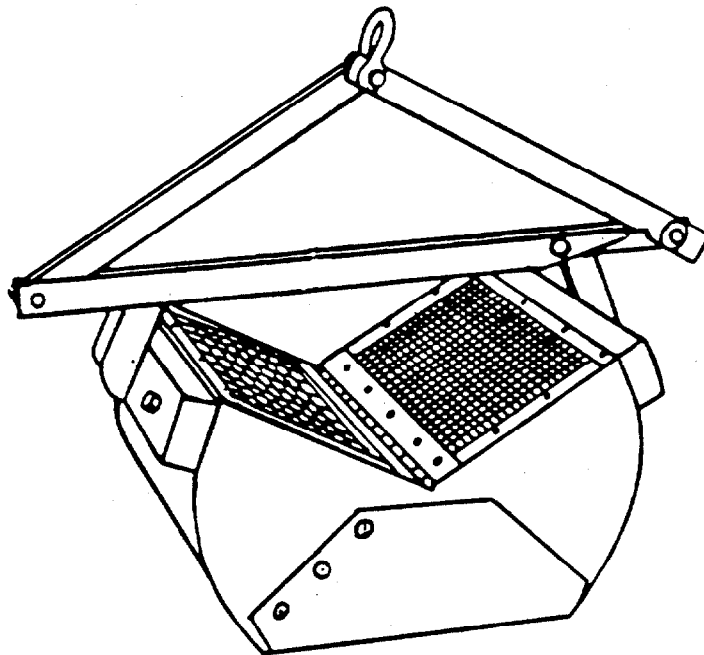


Figure 2-4. Ponar grab.

8. Slowly raise dredge clear of water surface.
9. Place Ponar into a stainless steel or Teflon tray and open. Lift Ponar clear of the tray.
10. Collect a suitable aliquot with a stainless steel lab spoon or equivalent and place sample into appropriate sample bottle. Appendix A contains containerization and preservation requirements.
11. Check for a Teflon liner in cap if required and secure cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach supplemented by a minimal holding time.
12. Label the sample bottle with the appropriate sample tag. Be sure to label the tag carefully and clearly, addressing all the categories or parameters. Complete all chain-of-custody documents and record in the field logbook.
13. Consult Appendix E, Decontamination for appropriate decontamination procedures to be used on sampling equipment after use and between sampling locations.

Sources

American Public Health Association. "Standard Methods for the Examination of Water and Wastewater" 14th Edition, American Public Health Association, Washington, D.C. 1975.

Lind, Owen T. "Handbook of Common Methods in Limnology." C.V. Mosby Company, St. Louis, 1974.

3.2.2 METHOD III-2: USE OF POND SAMPLER FOR THE COLLECTION OF SURFACE WATER SAMPLES

Discussion

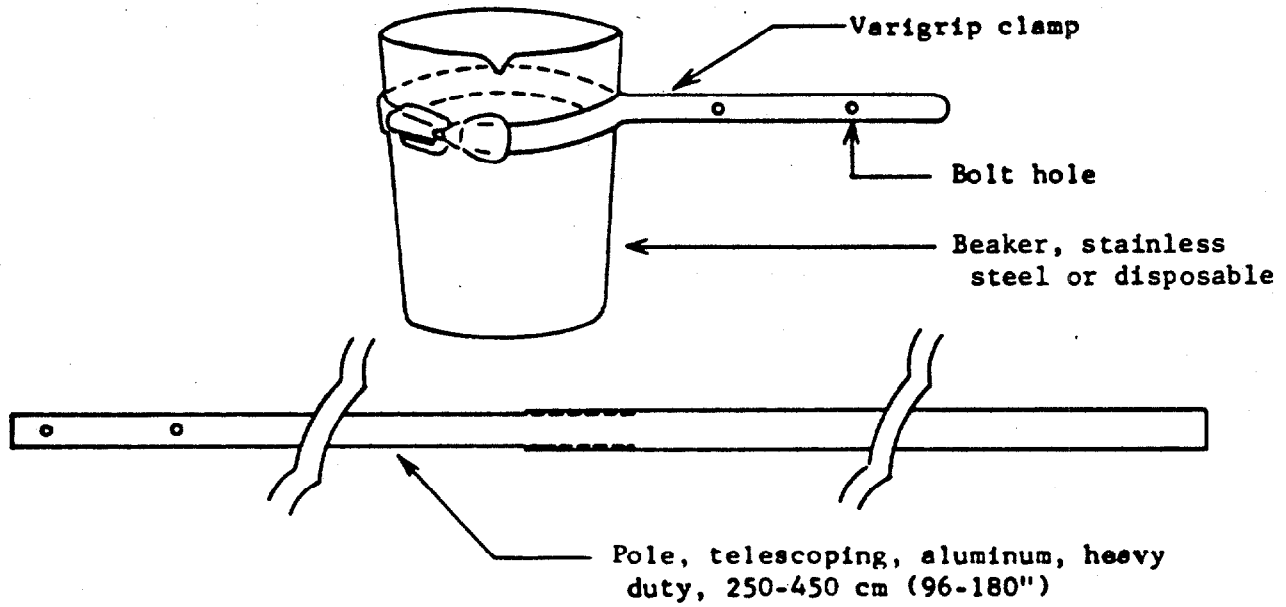
The pond sampler consists of an adjustable clamp attached to the end of a two- or three-piece telescoping aluminum tube that serves as the handle. The clamp is used to secure a sampling beaker (see Figure 3-1). The sampler is not commercially available, but it is easily and inexpensively fabricated. The tubes can be readily purchased from most hardware or swimming pool supply stores. The adjustable clamp and sampling beaker can be obtained from most laboratory supply houses. The materials required to fabricate the sampler are given in Appendix B.

Uses

The pond sampler is used to collect liquid waste samples from disposal ponds, pits, lagoons, and similar reservoirs. Grab samples can be obtained at distances as far as 3.5 m from the edge of the ponds. The tubular aluminum handle may bow when sampling very viscous liquids if sampling is not done slowly.

Procedures for Use

1. Assemble the pond sampler. Make sure that the sampling beaker and the bolts and nuts that secure the clamp to the pole are tightened properly.
2. With proper protective garment and gear, take grab samples by slowly submerging the precleaned beaker with minimal surface disturbance.
3. Retrieve the pond sampler from the surface water with minimal disturbance.
4. Remove the cap from the sample bottle and slightly tilt the mouth of the bottle below the dipper/device edge.
5. Empty the sampler slowly, allowing the sample stream to flow gently down the side of the bottle with minimal entry turbulence.
6. Continue delivery of the sample until the bottle is almost completely filled.
7. Select appropriate sample bottles and preserve the sample if necessary as per guidelines in Appendix A.
8. Check that a Teflon liner is present in the cap if required. Secure the cap tightly.



Source: Reference 1.

Figure 3-1. Pond sampler.

9. Label the sample bottle with an appropriate sample tag. Be sure to label the tag carefully and clearly, addressing all the categories or parameters. Record the information in the field logbook and complete the chain-of-custody documents.
10. Properly clean and decontaminate the equipment prior to reuse or storage using recommended guidelines of Appendix E.

Sources

deVera, E.R., Simmons, B.P., Stephens, R.D., and Storm, D.L. "Samplers and Sampling Procedures for Hazardous Waste Streams," EPA-600/2-80-018, January 1980.

GCA Corporation, "Quality Assurance Plan, Love Canal Study - Appendix A, Sampling Procedures," EPA Contract 68-02-3168.

3.2.4 METHOD III-4: COLLECTION OF WATER SAMPLES FROM DEPTH WITH A KEMMERER BOTTLE

Discussion

The kemmerer bottle is a messenger-activated water sampling device (see Figure 3-4). In the open position water flows easily through the device. Once lowered to the desired depth a messenger is dropped down the sample line tripping the release mechanism and closing the bottle. In the closed position the bottle is sealed, both on top and bottom, from any additional contact with the water column and can be retrieved.

Most commercially available Kemmerer bottles are of brass or plastic construction. Modification of existing systems with nonreactive materials such as Teflon, glass or stainless steel would be only partially successful due to the complicated machining necessary for the release mechanism. Other modifications such as a stoppered bottom drain are simpler and useful in minimizing sample disturbance during transfer to the appropriate containers.

Uses

The Kemmerer bottle is currently the most practical method of collecting discrete, at-depth samples from surface waters or vessels where the collection depth exceeds the lift capacity of pumps. The application is limited however by the incompatibility of various construction materials with some analytical techniques. Proper selection, i.e., all metal assemblies for organic analysis or all plastic assemblies for trace element analysis, will overcome this deficiency.

Procedures for Use

1. Inspect Kemmerer bottle for thorough cleaning and insure that sample drain valve is closed (if bottle is so equipped).
2. Measure and then mark sample line at desired sampling depth.
3. Open bottle by lifting top stopper-trip head assembly.
4. Gradually lower bottle until desired level is reached (predesignated mark from Step 2).
5. Place messenger on sample line and release.
6. Retrieve sampler; hold sampler by center stem to prevent accidental opening of bottom stopper.
7. Rinse or wipe off exterior of sampler body (wear proper gloves and protective clothing).

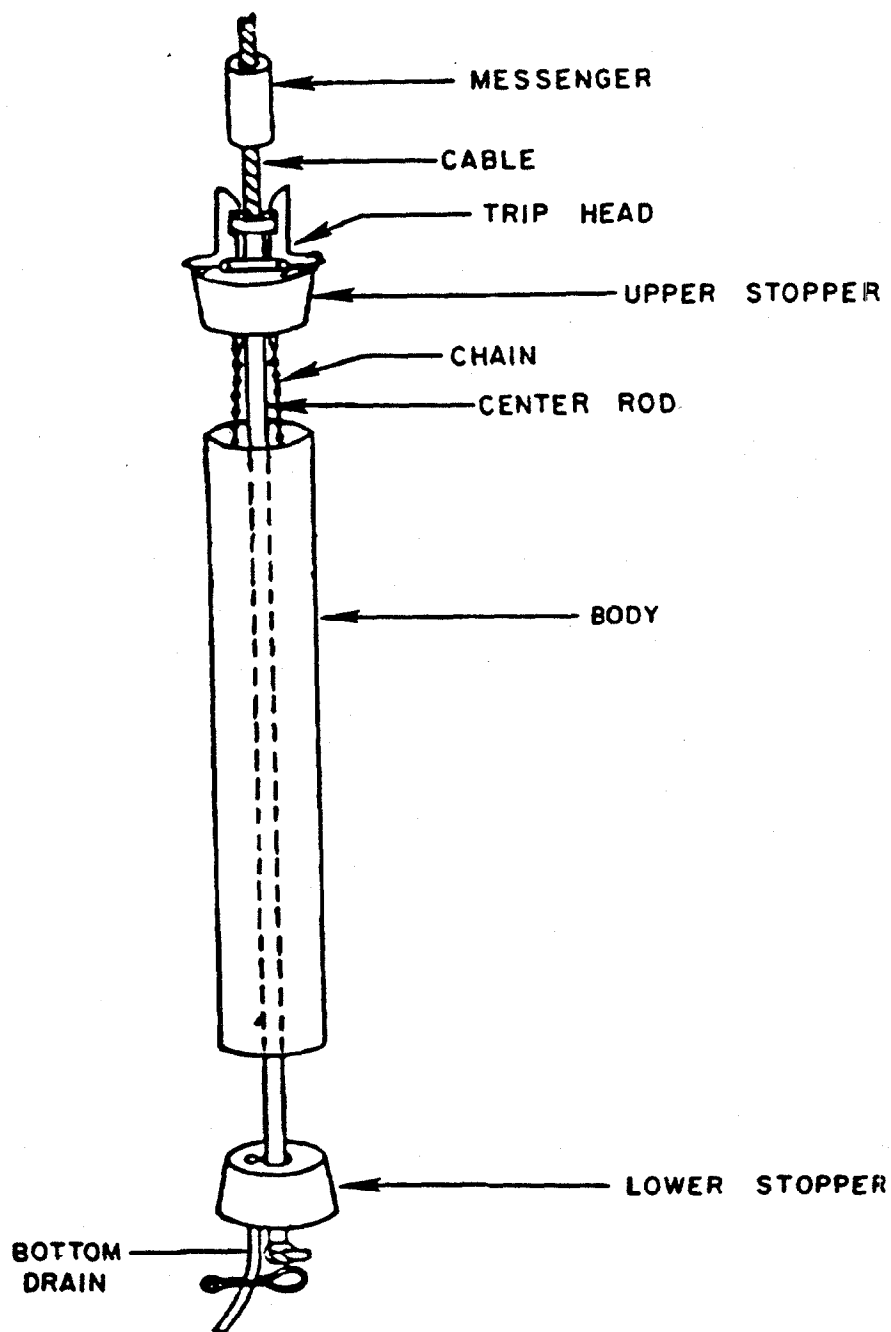


Figure 3-4. Modified Kemmerer sampler.

8. Recover sample by grasping lower stopper and sampler body with one hand (gloved), and transfer sample by either (a) lifting top stopper with other hand and carefully pouring contents into sample bottles, or (b) holding drain valve (if present) over sample bottle and opening valve.
9. Allow sample to flow slowly down side of sample bottle with minimal disturbance.
10. Select sample bottles and preserve the sample if necessary as per guidelines in Appendix A.
11. Check that a Teflon liner is present in the cap if required. Secure the cap tightly.
12. Label the sample bottle with an appropriate tag. Be sure to complete the tag with all necessary information. Record the information in the field logbook and complete all chain-of-custody records.
13. Decontaminate sampler and messenger or place in plastic bag for return to lab. See Appendix E for general decontamination procedures.

Sources

U.S. Environmental Protection Agency, "Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities." EPA-530/SW-611, August 1977.

3.4.3 METHOD III-9: SAMPLING MONITOR WELLS WITH A BUCKET TYPE BAILER

Discussion

Bucket type bailers are tall narrow buckets equipped with a check valve on the bottom. This valve allows water to enter from the bottom as the bailer is lowered, then prevents its release as the bailer is raised (see Figure 3-8). Top filling bailers are also available and may be useful for well purging but generally result in increased sample turbulence and are not recommended for sample acquisition.

Uses

This device is particularly useful when samples must be recovered from depths greater than the range (or capability) of suction lift pumps, when volatile stripping is of concern, or when well casing diameters are too narrow to accept submersible pumps. It is the method of choice for the collection of samples which are susceptible to volatile component stripping or degradation due to the aeration associated with most other recovery systems. Samples can be recovered with a minimum of aeration if care is taken to gradually lower the bailer until it contacts the water surface and is then allowed to sink as it fills. Teflon is generally the best construction material but other materials (PVC, stainless steel, etc.) are acceptable if compatible with designated sample analysis. The primary disadvantages of bailers are their limited sample volume and inability to collect discrete samples from a depth below the water surface.

Procedures for Use

1. Using clean, noncontaminating equipment, i.e., an electronic level indicator (avoid indicating paste), determine the water level in the well, then calculate the fluid volume in the casing.
2. Purge well as per Methods III-7 or III-8.
3. Attach precleaned bailer to cable or line for lowering.
4. Lower bailer slowly until it contacts water surface.
5. Allow bailer to sink and fill with a minimum of surface disturbance.
6. Slowly raise bailer to surface. Do not allow bailer line to contact ground.
7. Tip bailer to allow slow discharge from top to flow gently down the side of the sample bottle with minimum entry turbulence.
8. Repeat steps 2-5 as needed to acquire sufficient volume.
9. Select sample bottles and preserve the sample, if necessary, according to the guidelines in Appendix A.

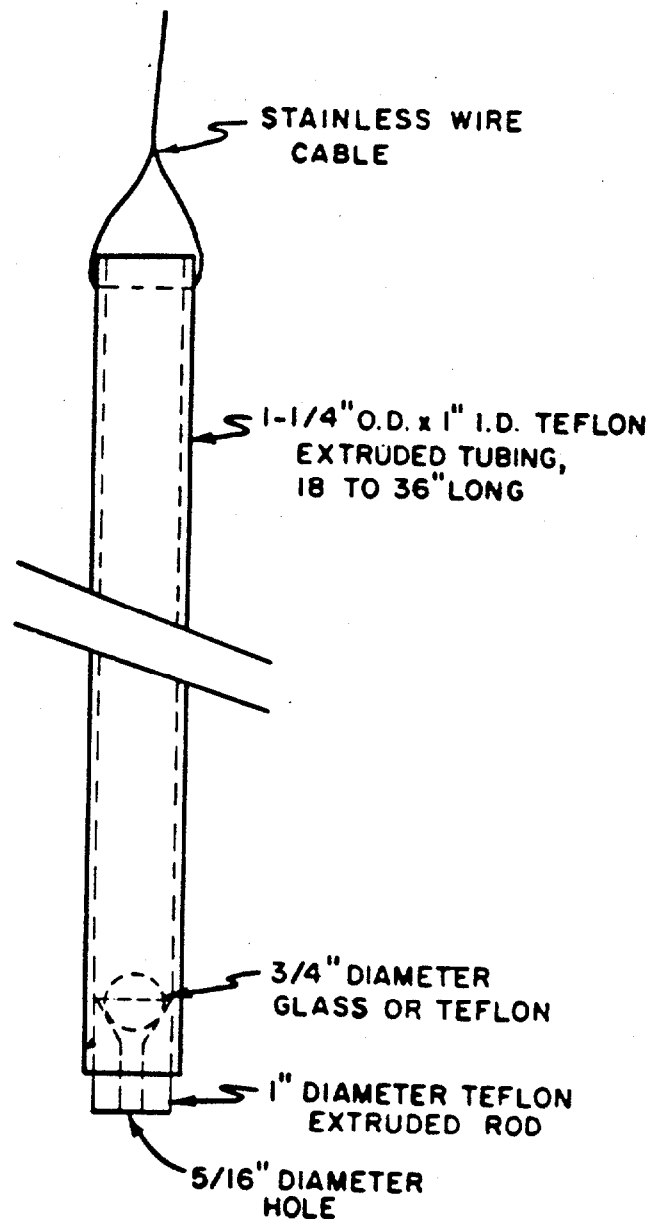


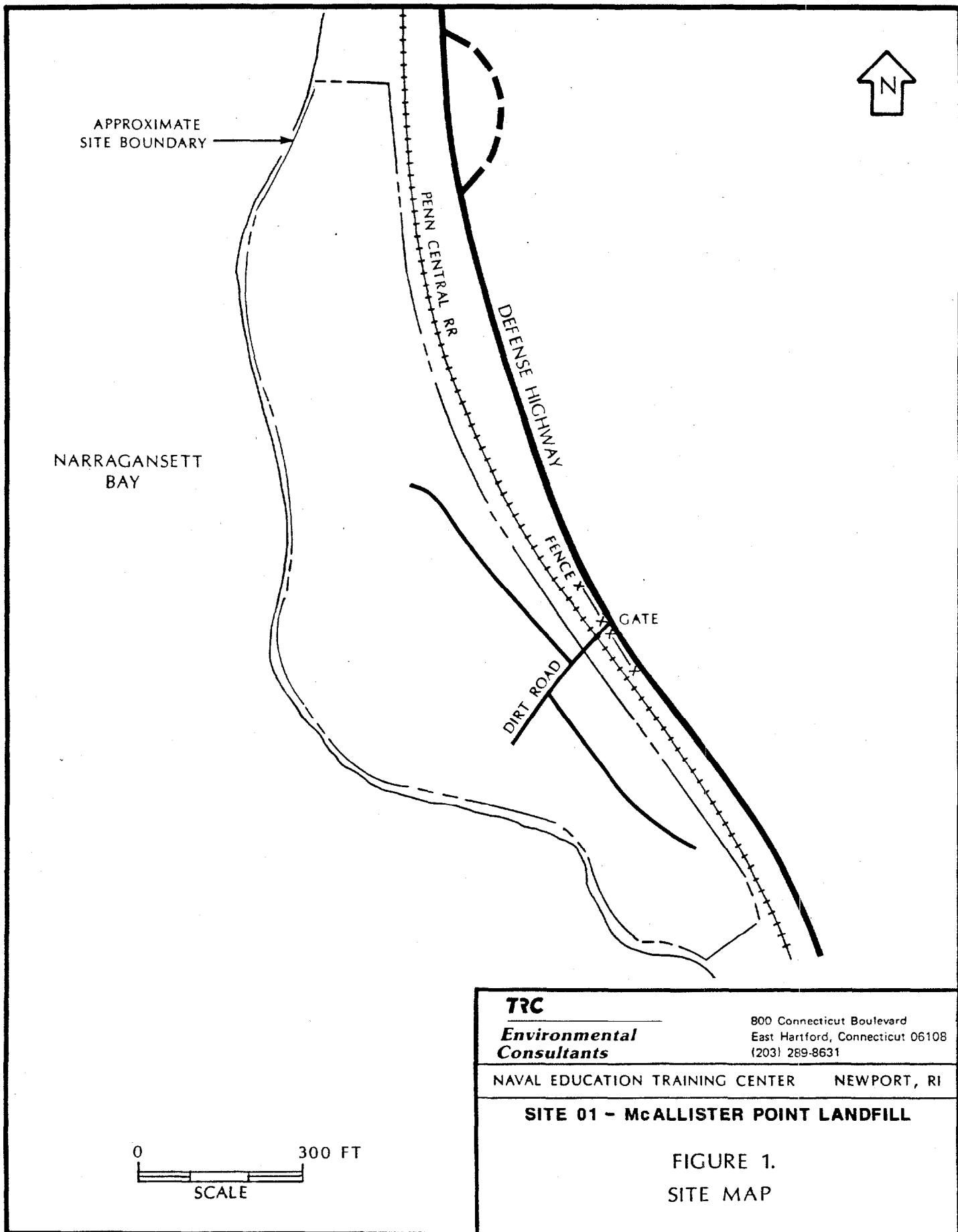
Figure 3-8. Teflon bailer.

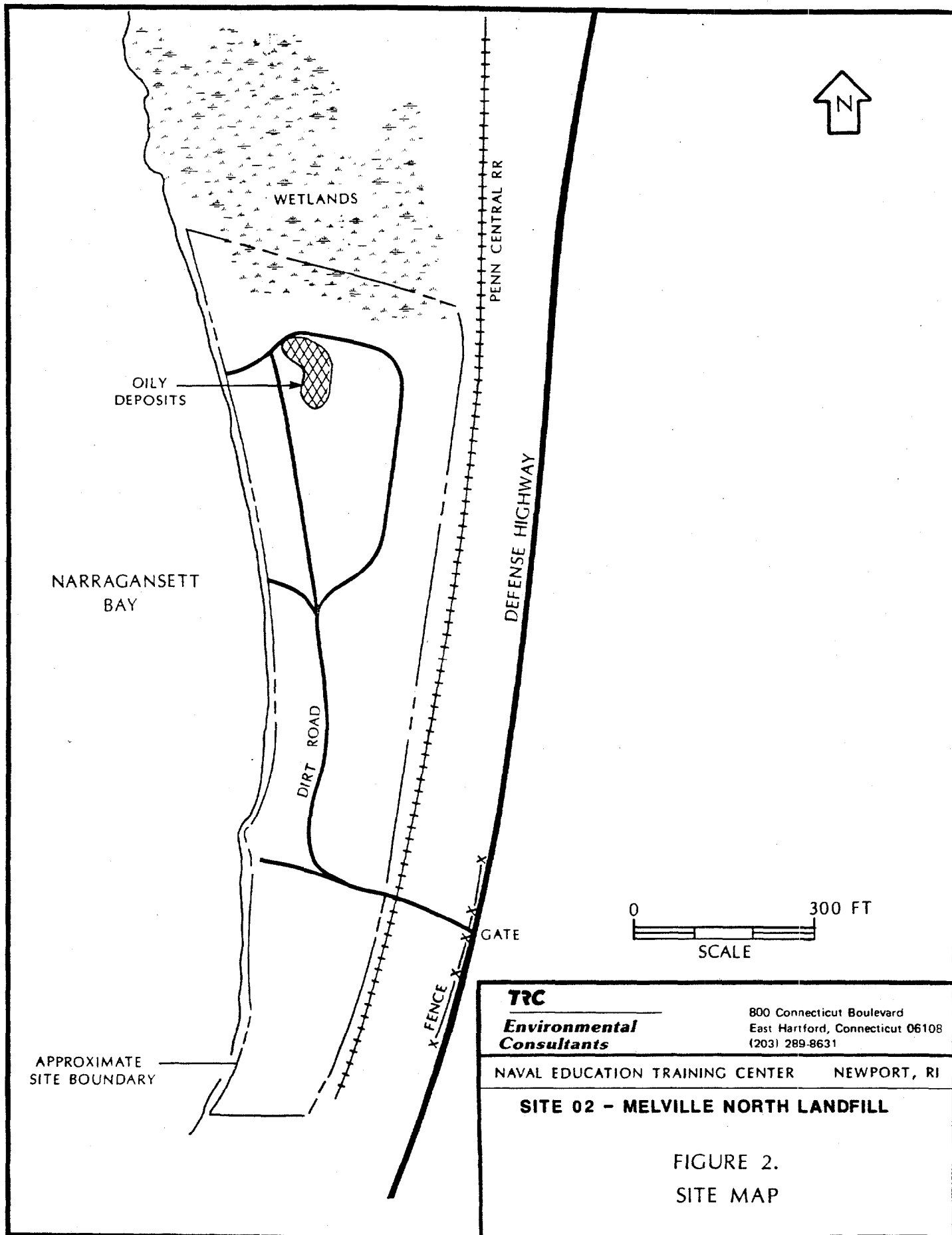
10. Check that a Teflon-liner is present in cap if required. Secure the cap tightly.
11. Label the sample bottle with an appropriate tag. Be sure to complete the tag with all necessary information. Record the information in the field logbook and complete all chain-of-custody documents.
12. Thoroughly decontaminate the bailer after each use according to specific laboratory instructions, or the general guidelines in Appendix E. In some cases, especially where trace analysis is desired, it may be prudent to use a separate bailer for each well.

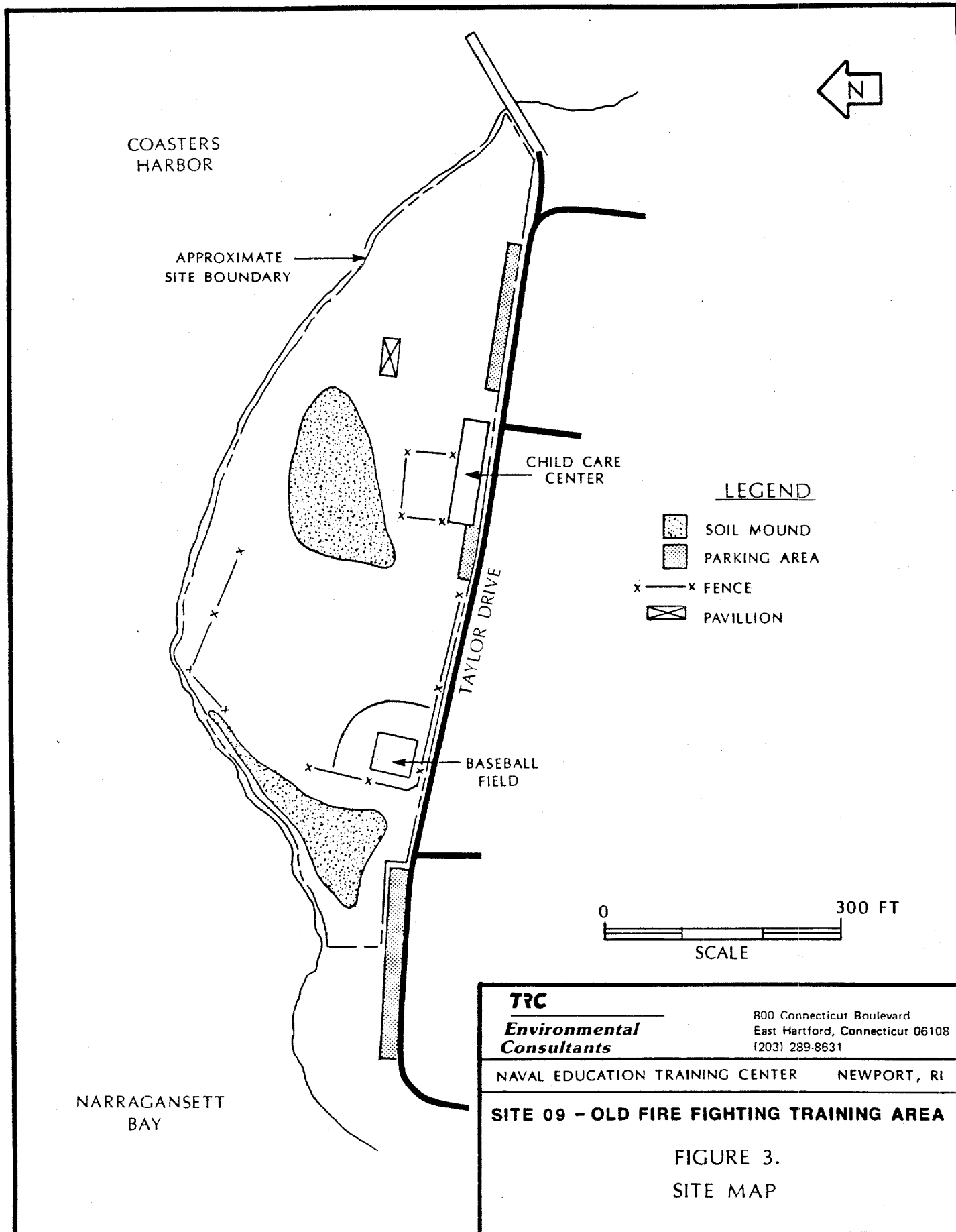
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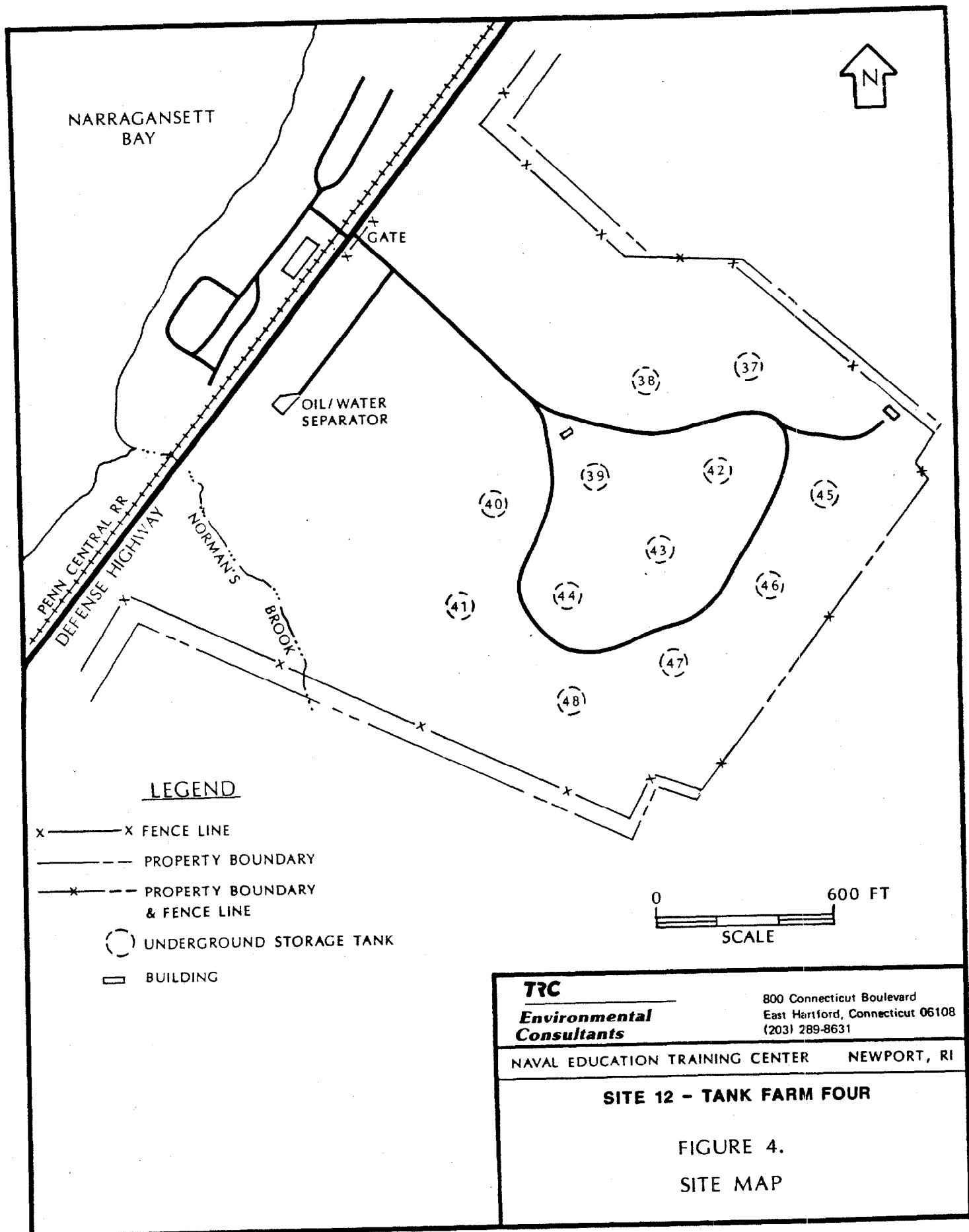
Dunlap, W. J., McNabb, J. F., Scalf, M. R. and Crosby, R. L., "Sampling for Organic Chemicals and Microorganism in the Subsurface. "EPA-600/2-77-176, August 1977.

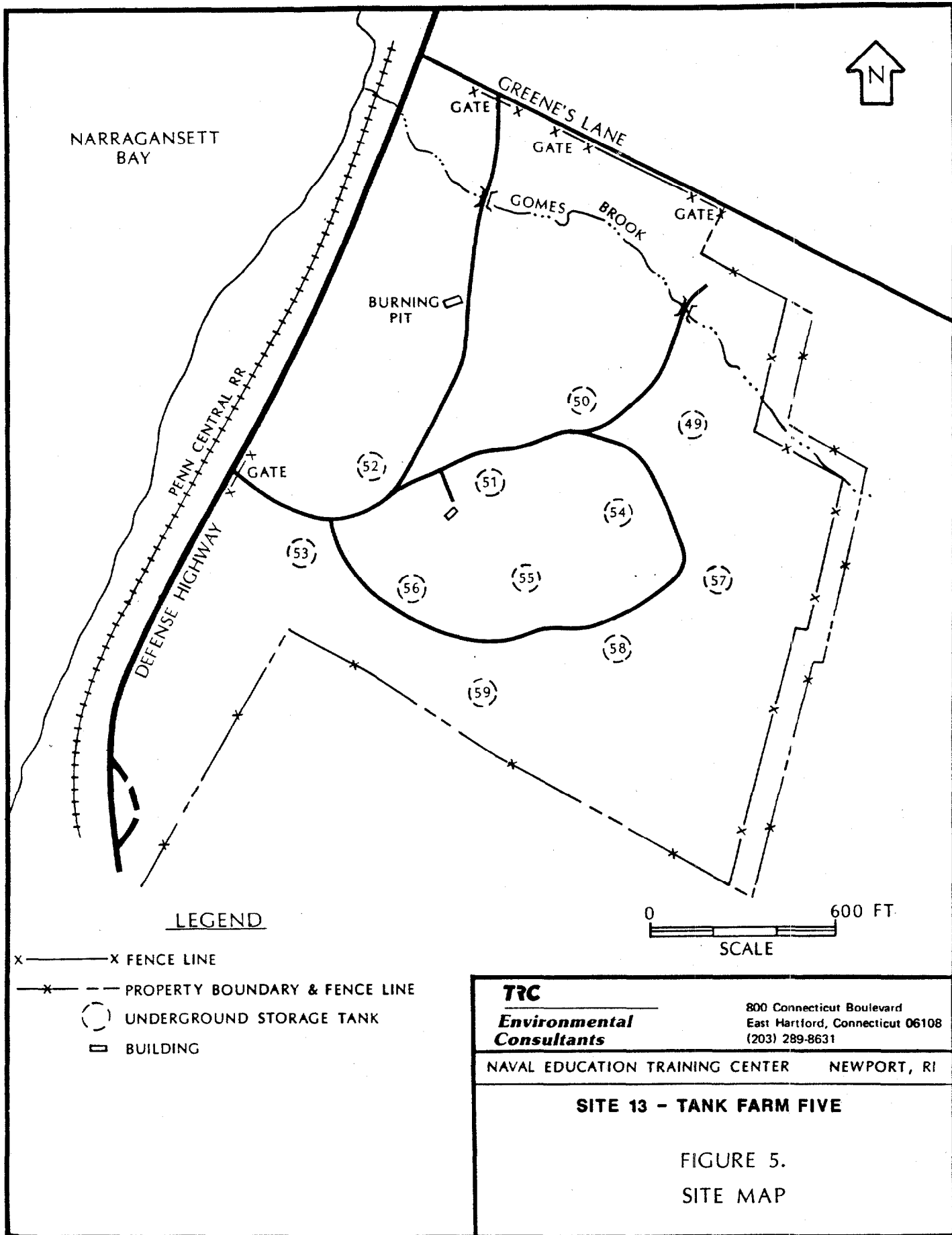
FIGURES

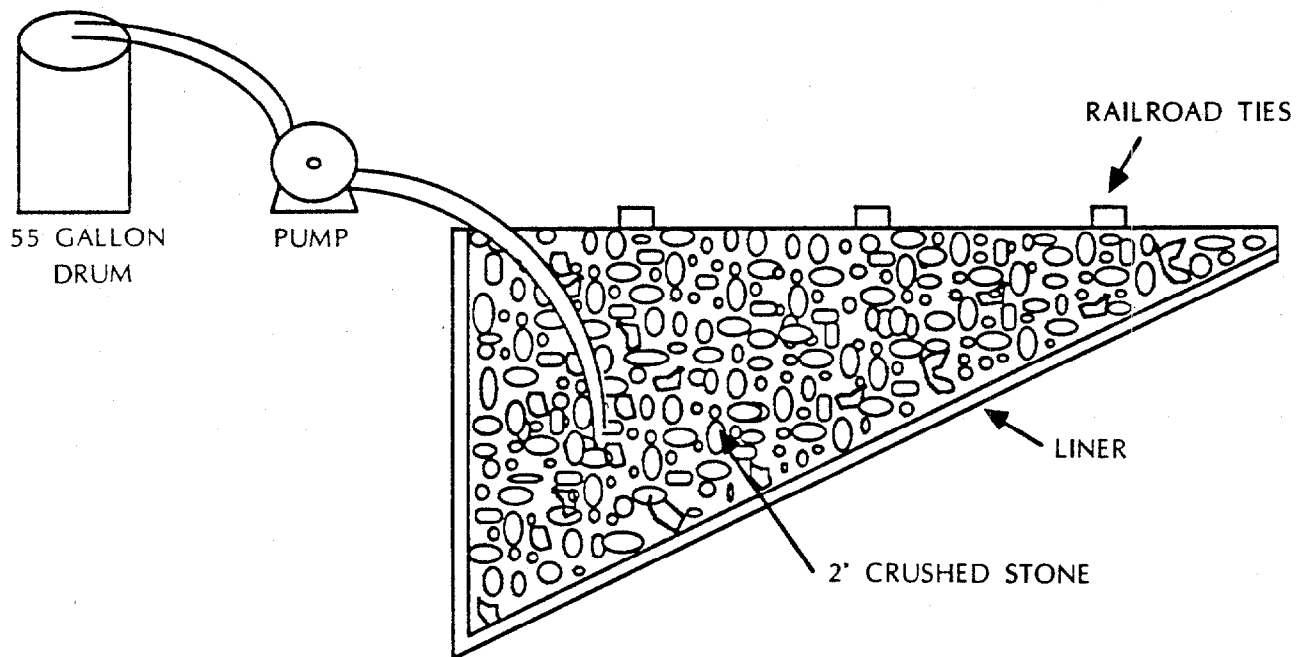












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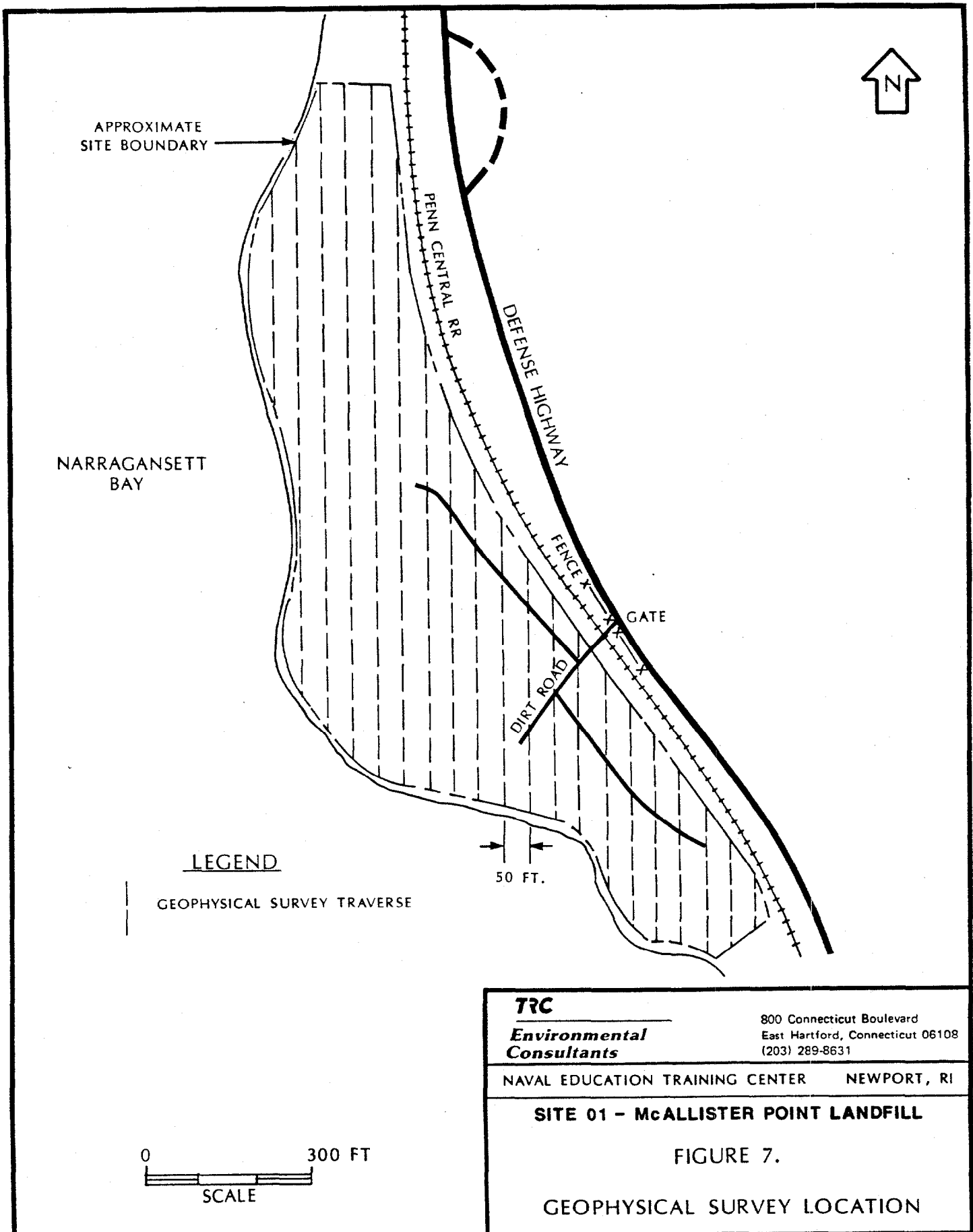
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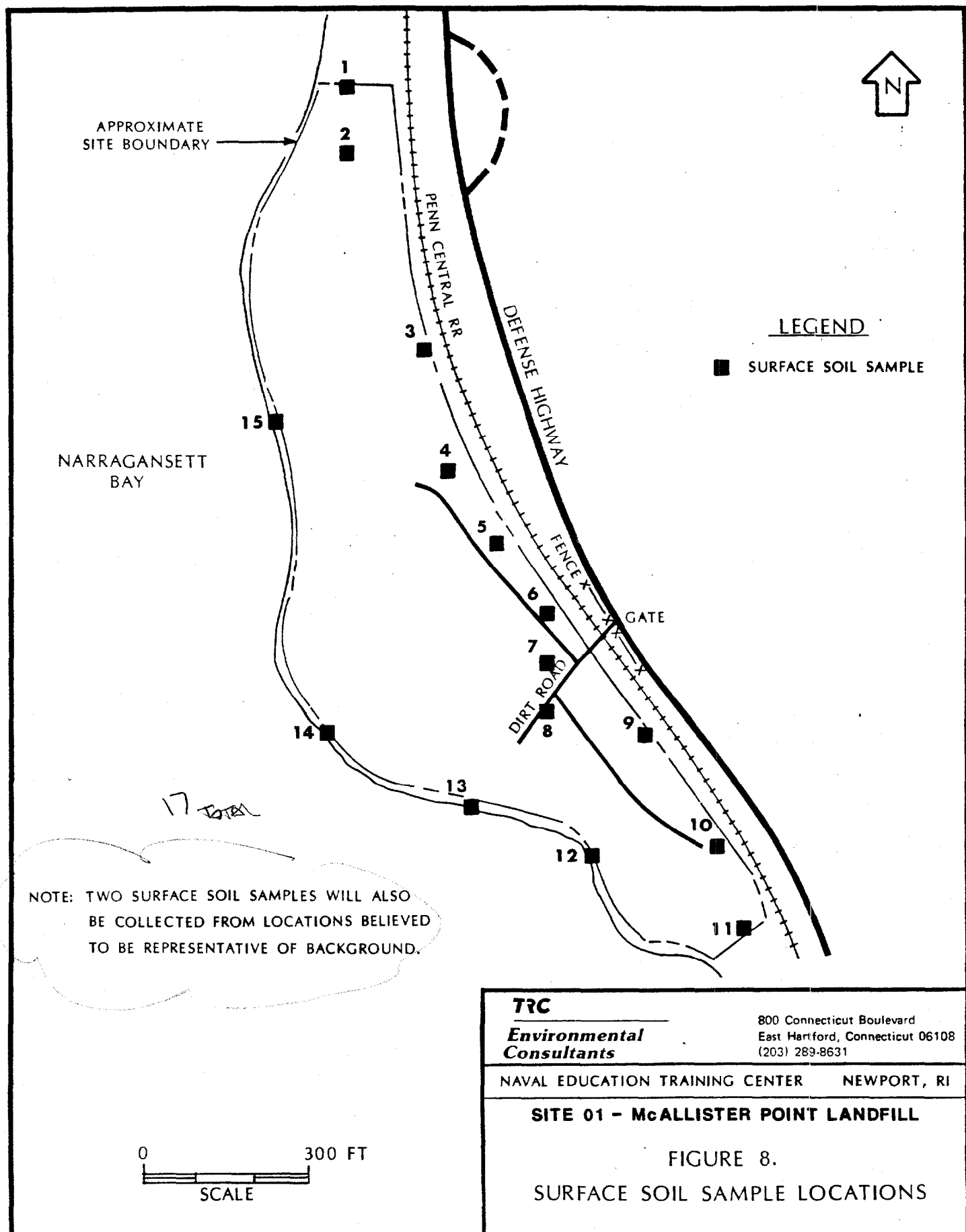
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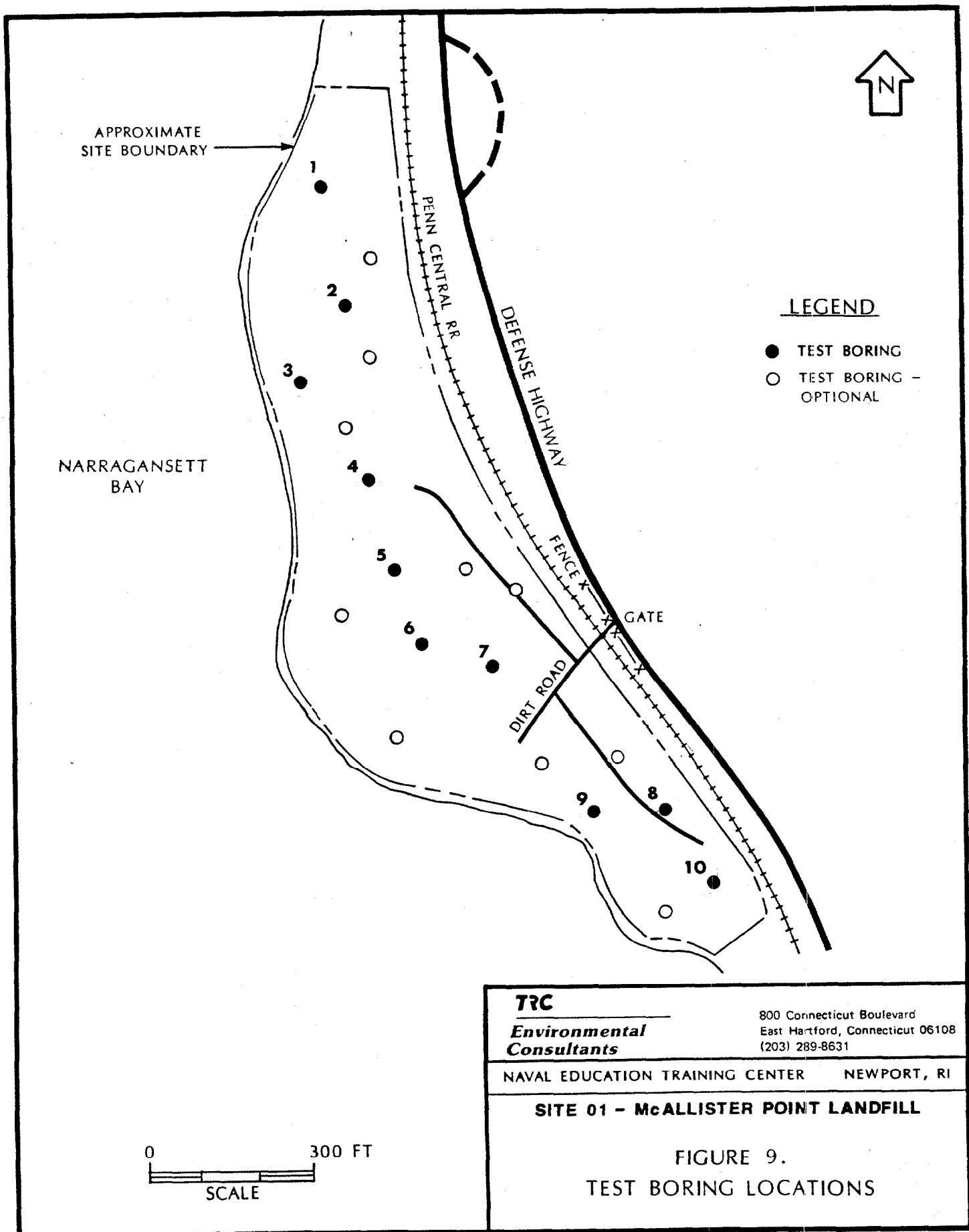
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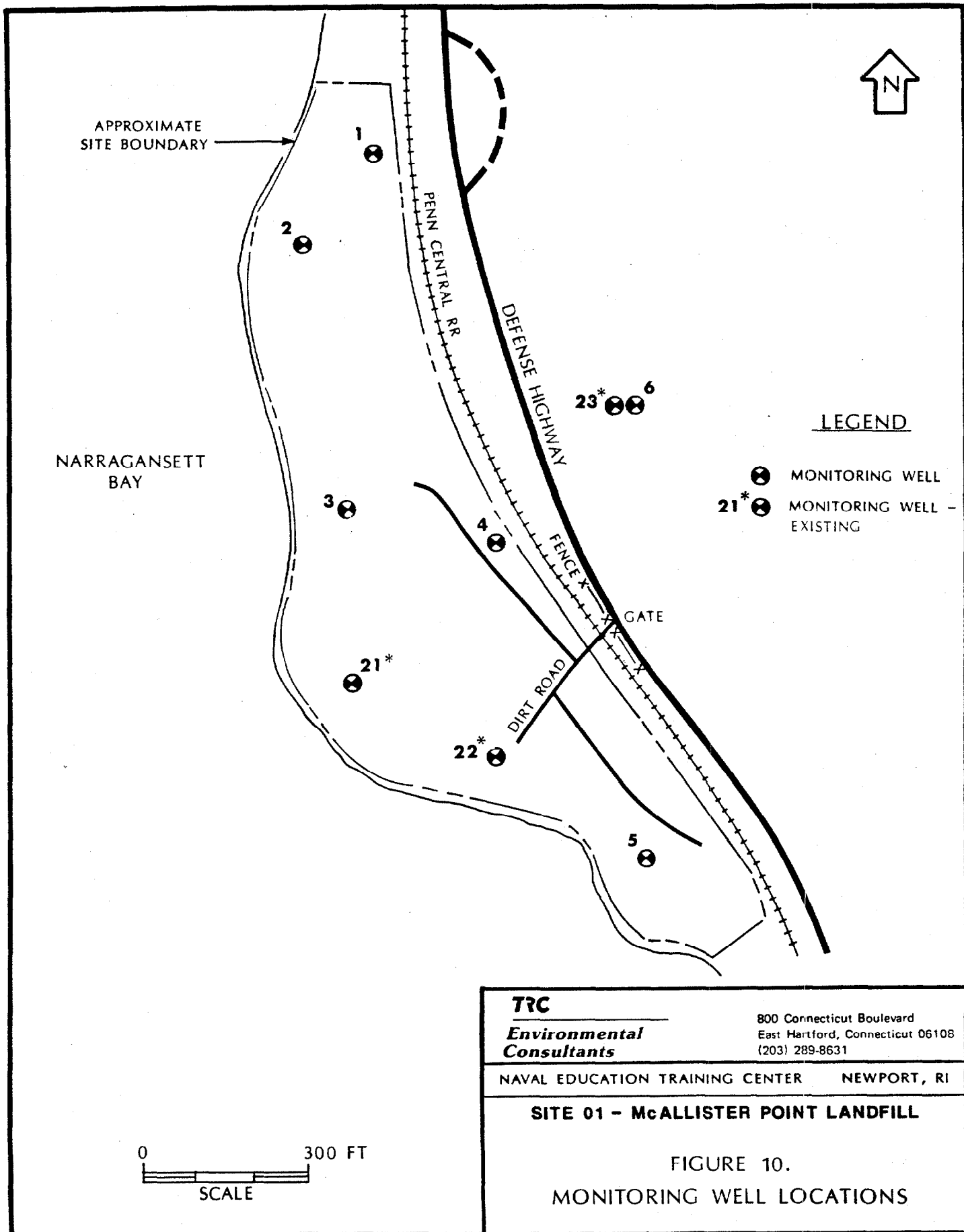
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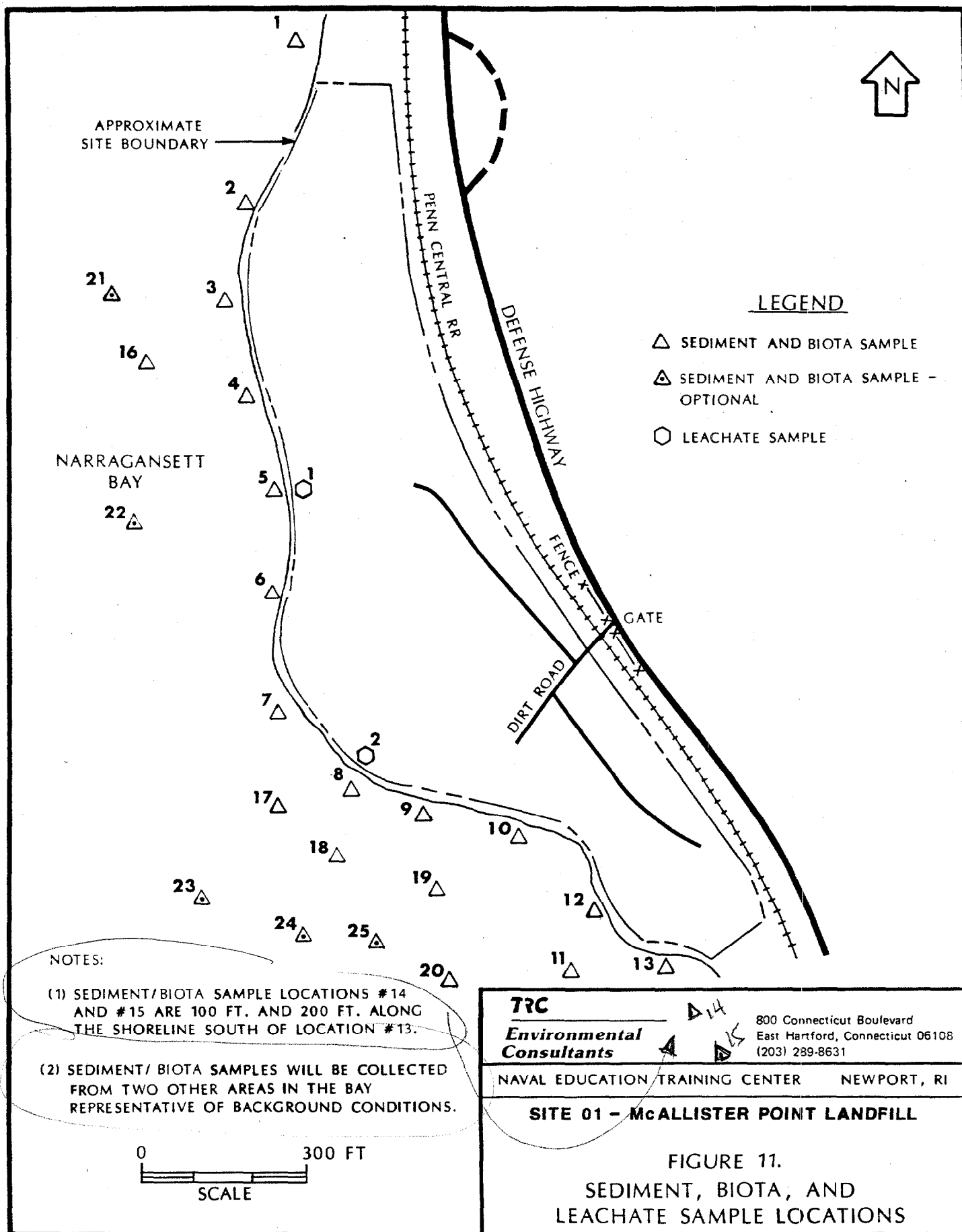
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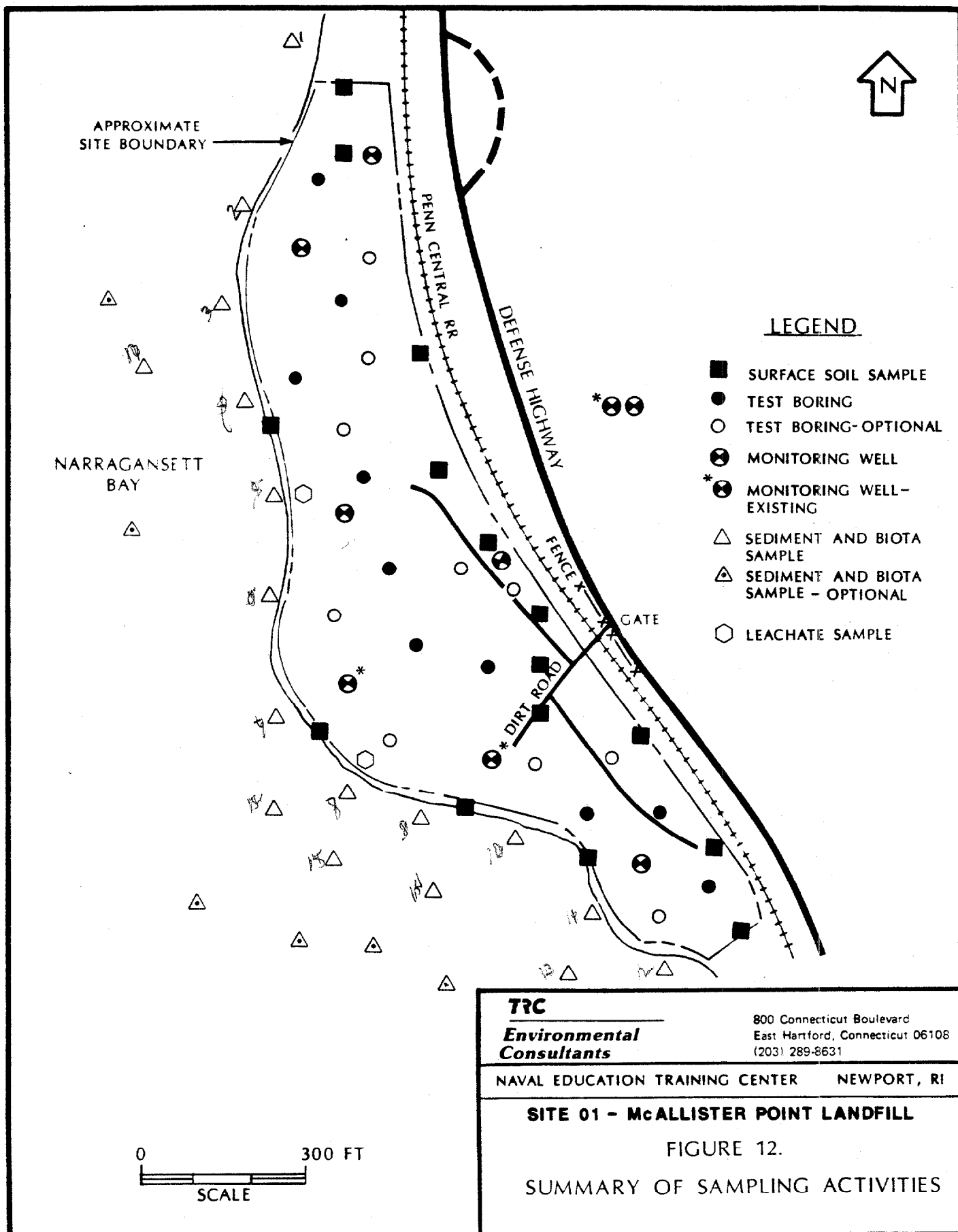


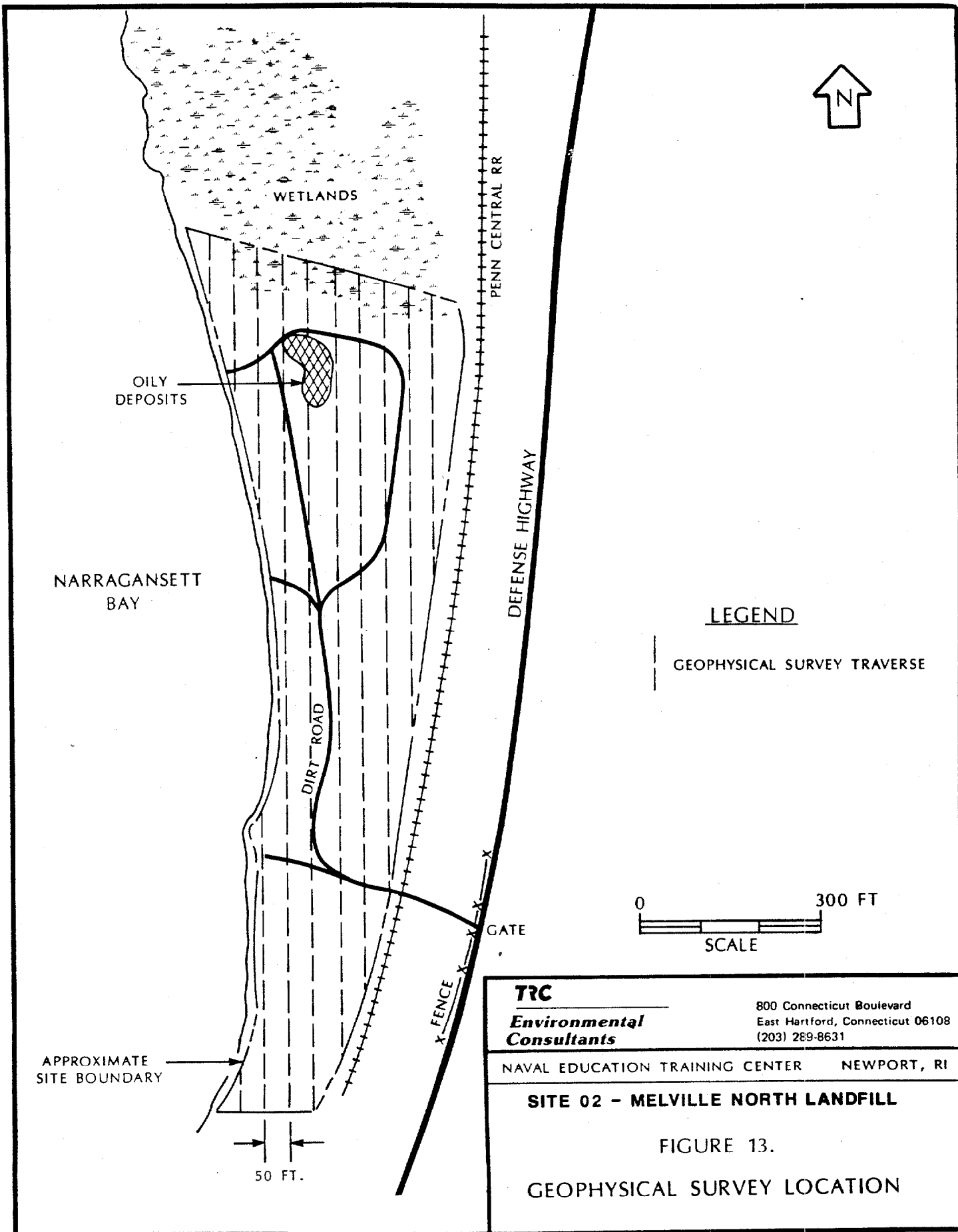


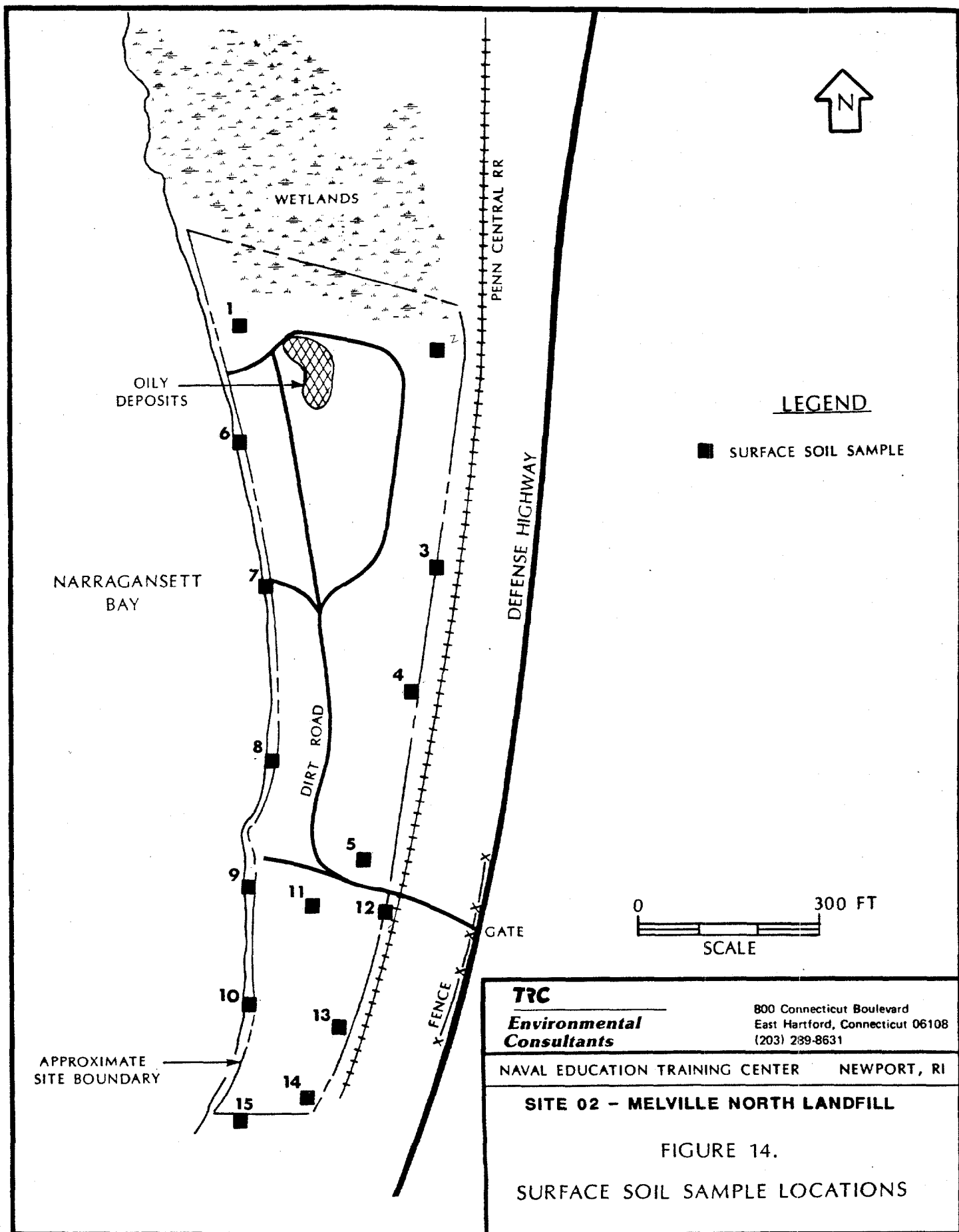












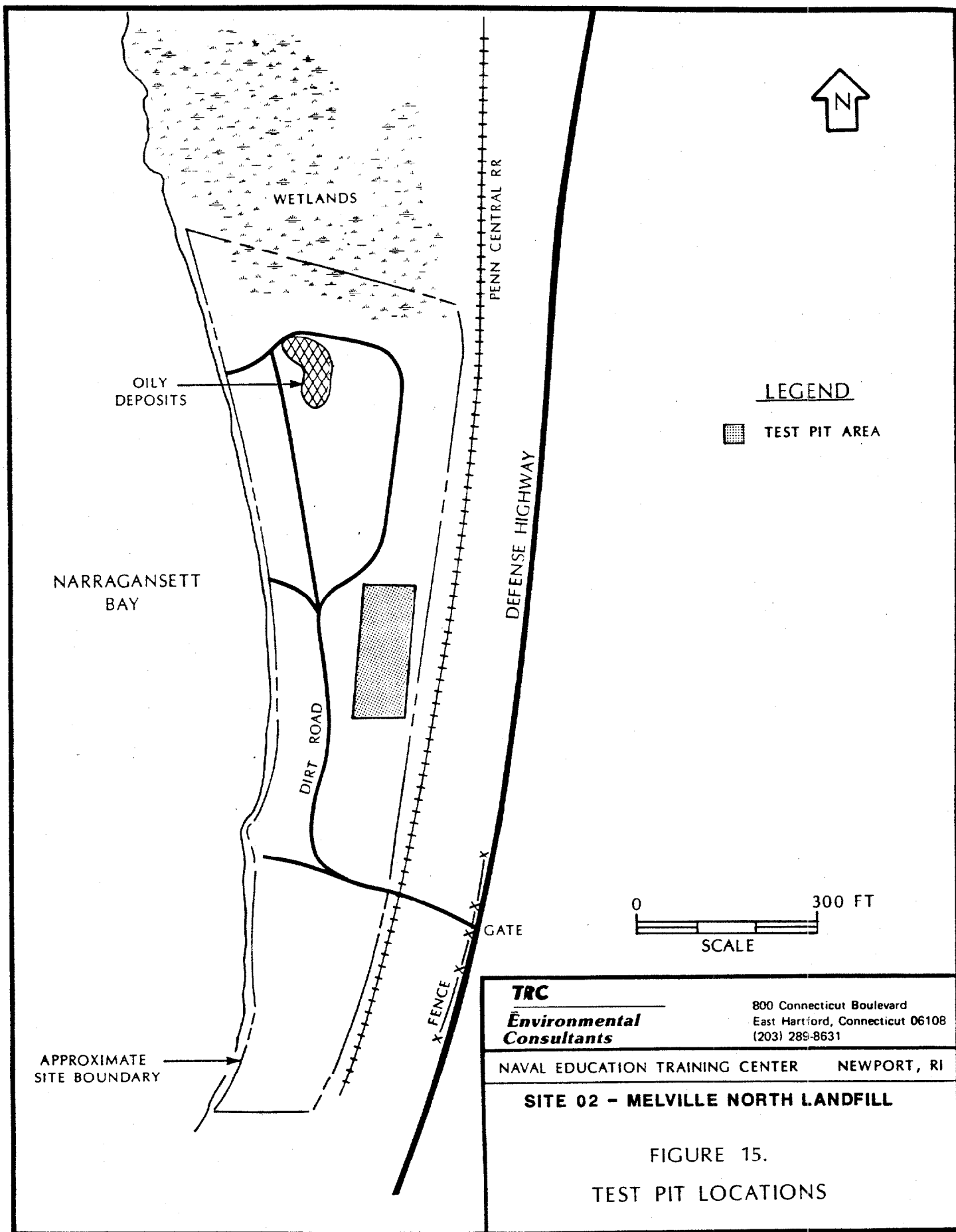
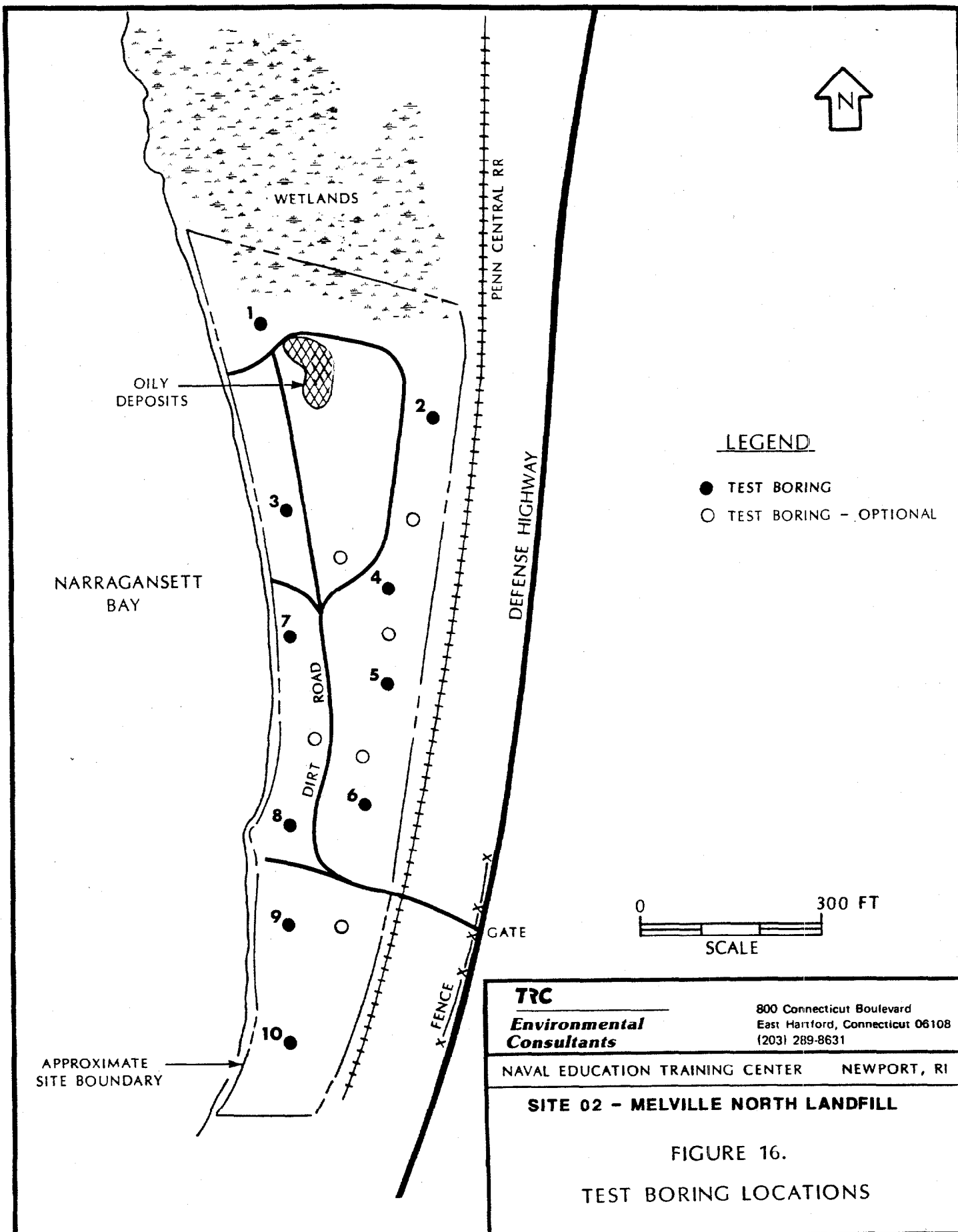
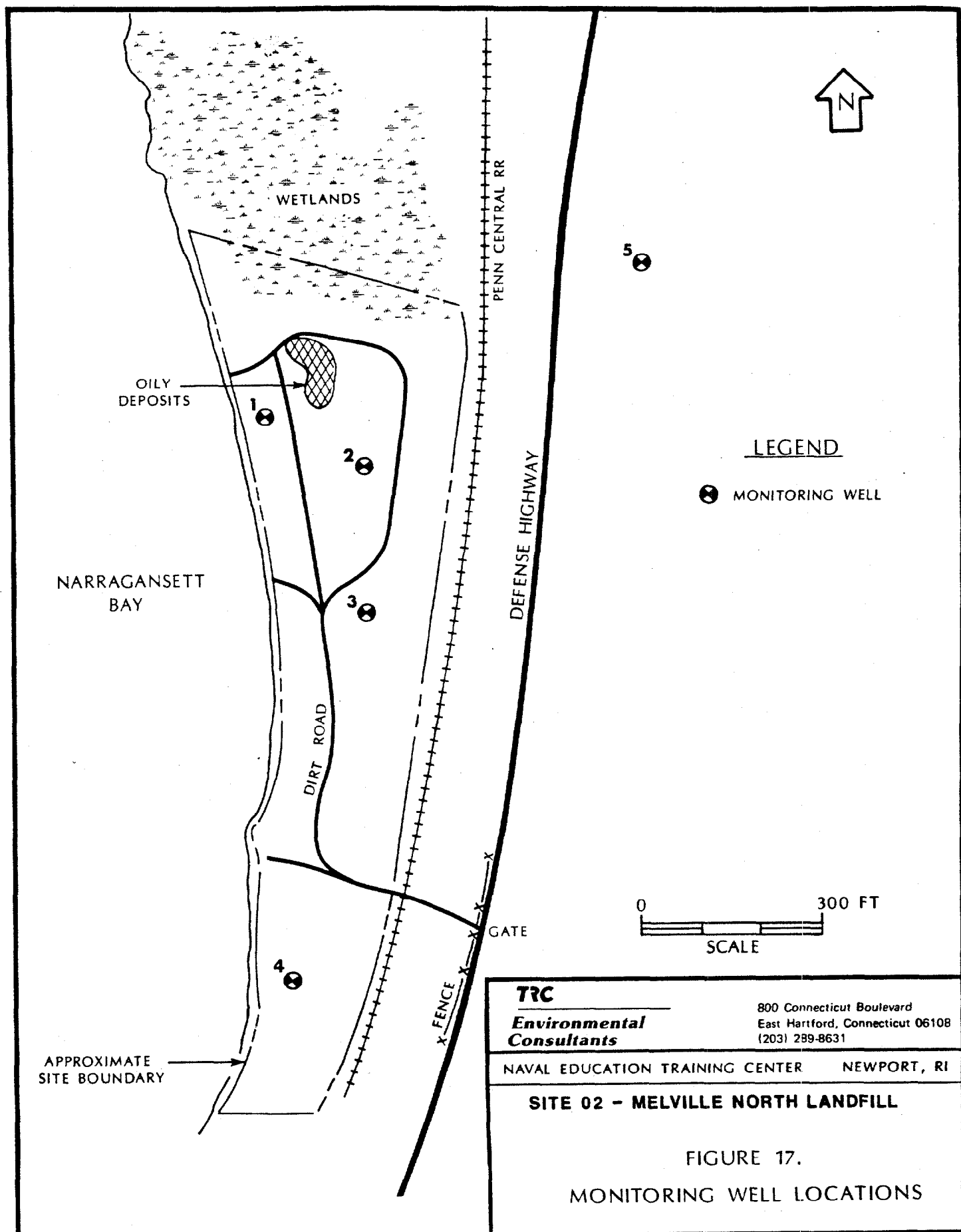
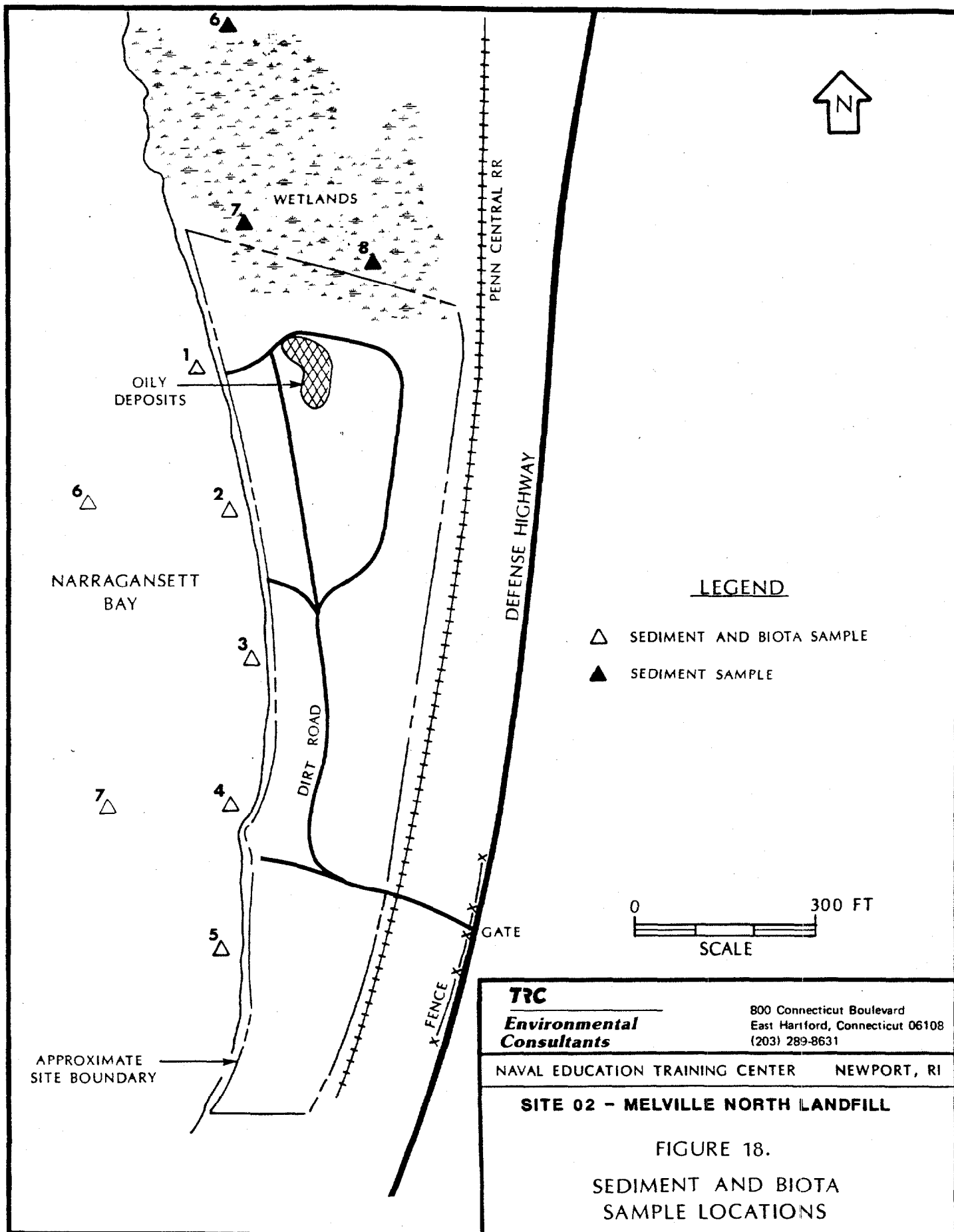
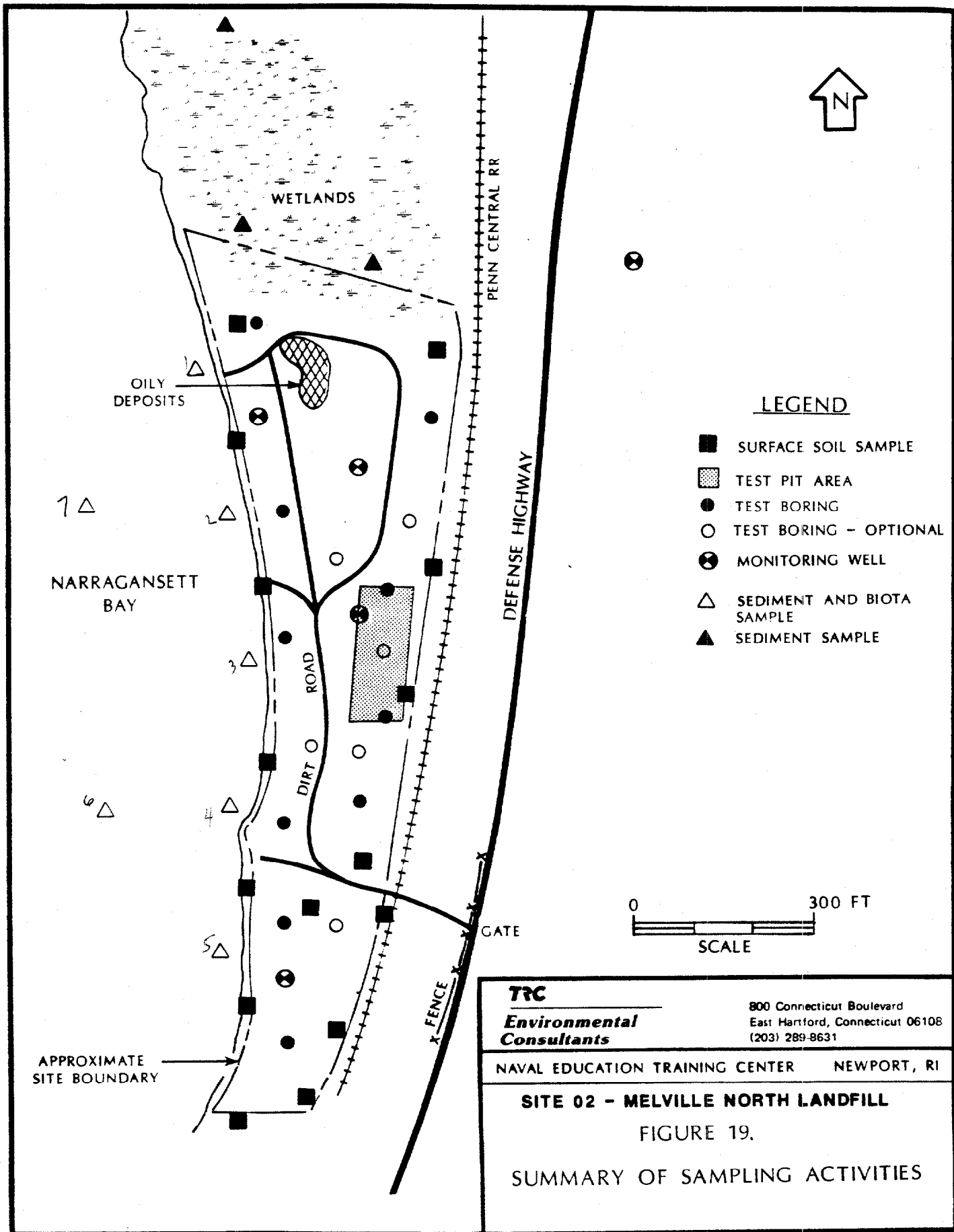


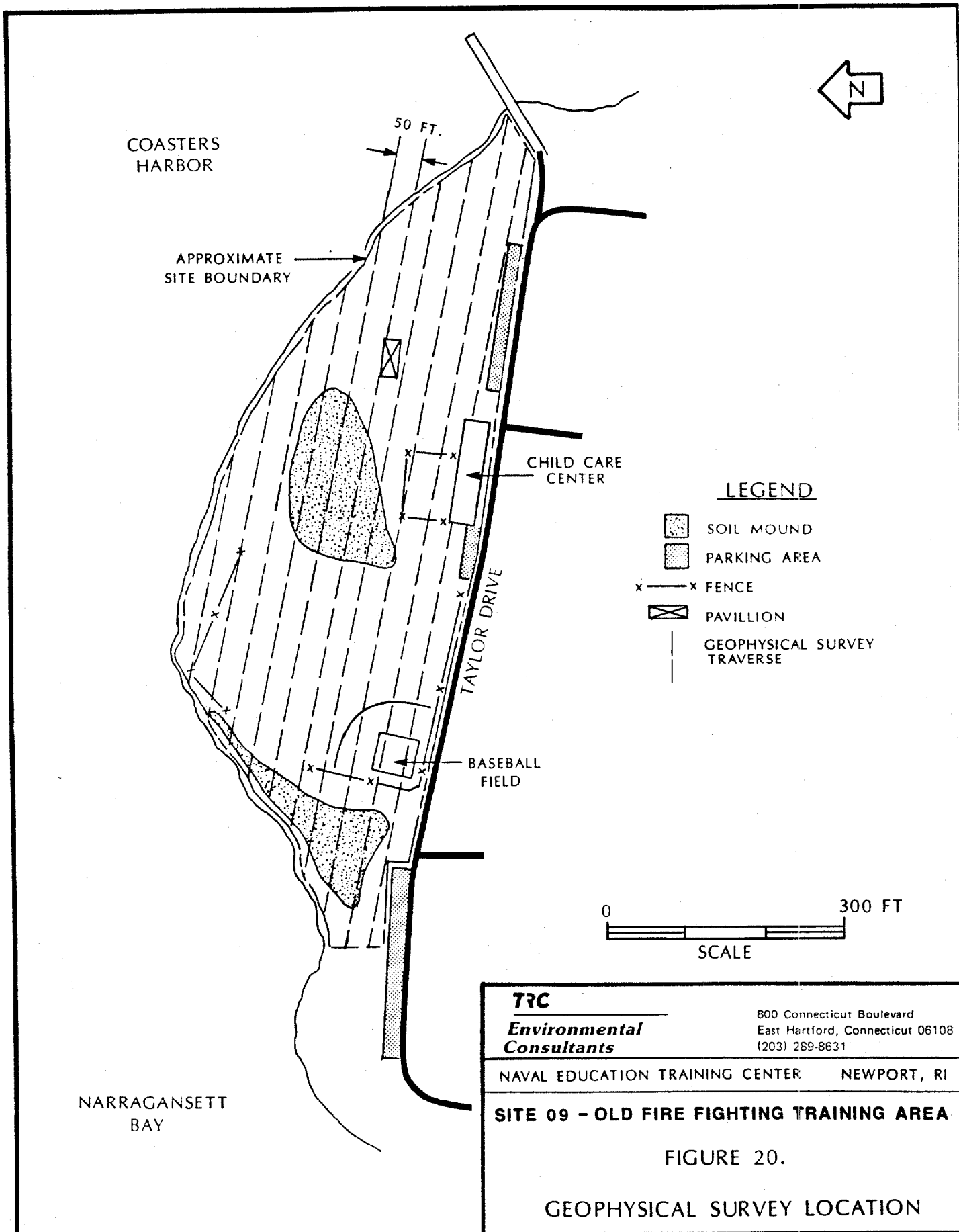
FIGURE 15.
TEST PIT LOCATIONS

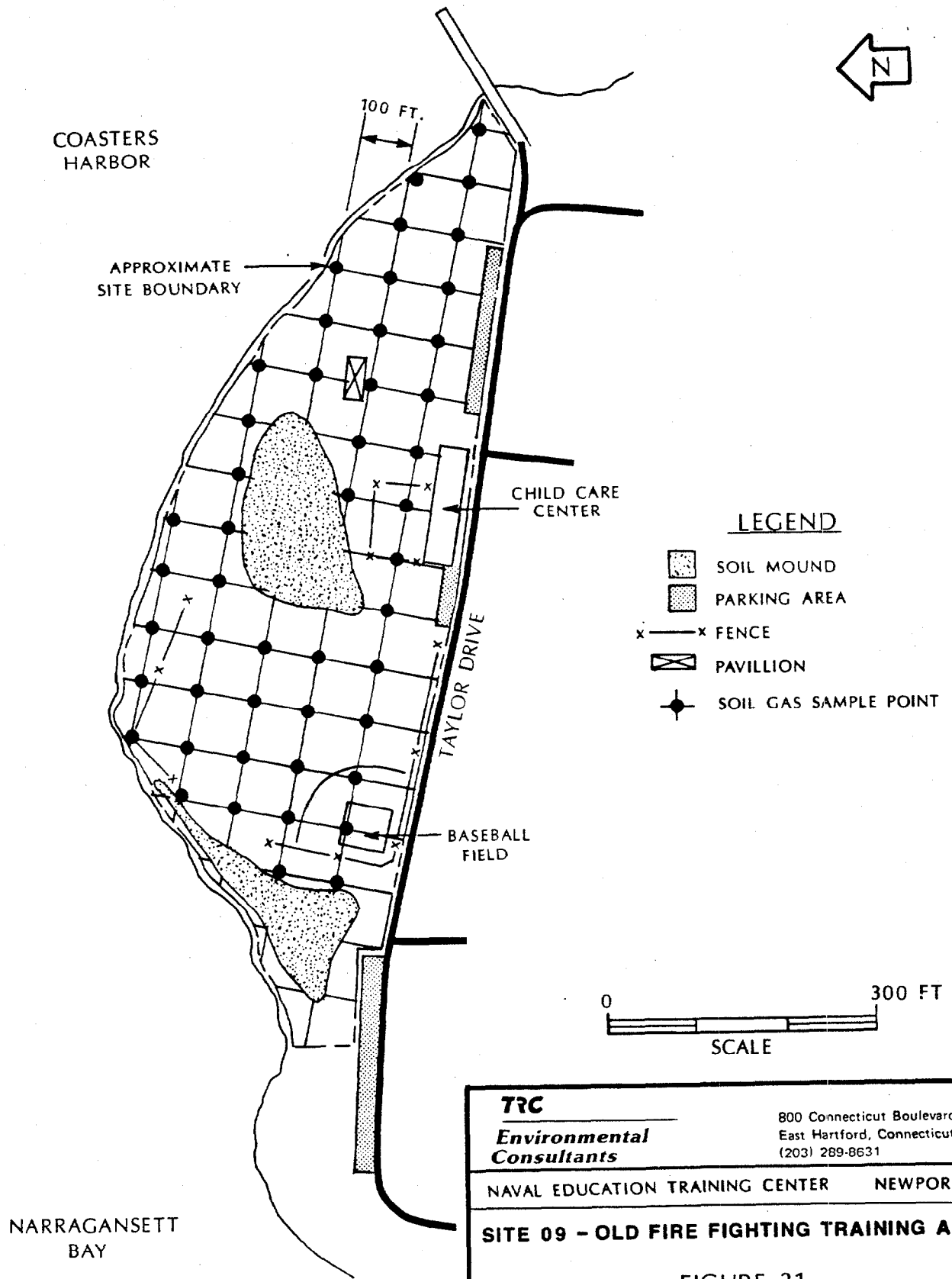












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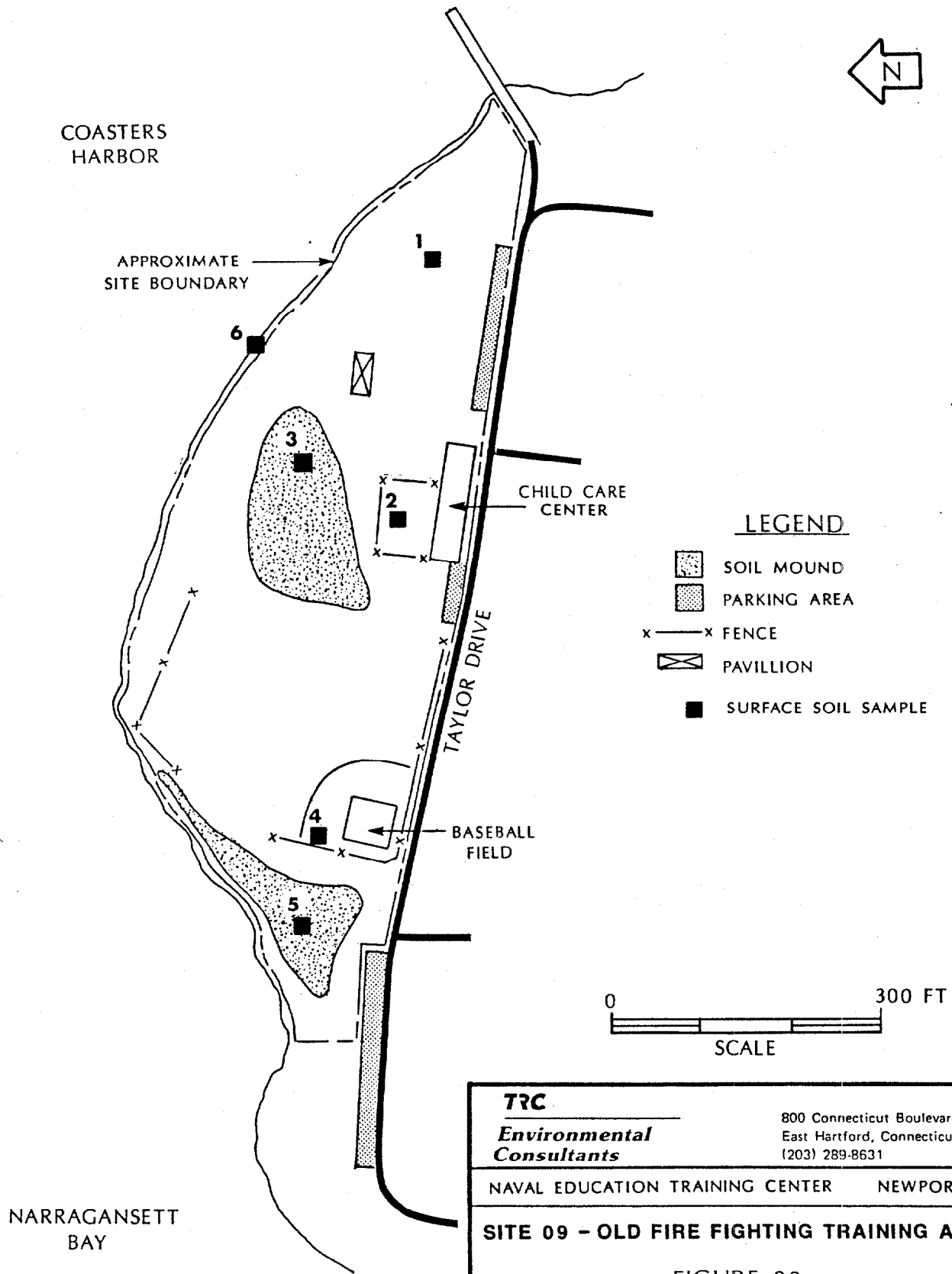
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FIGURE 21.

SOIL GAS SURVEY LOCATION



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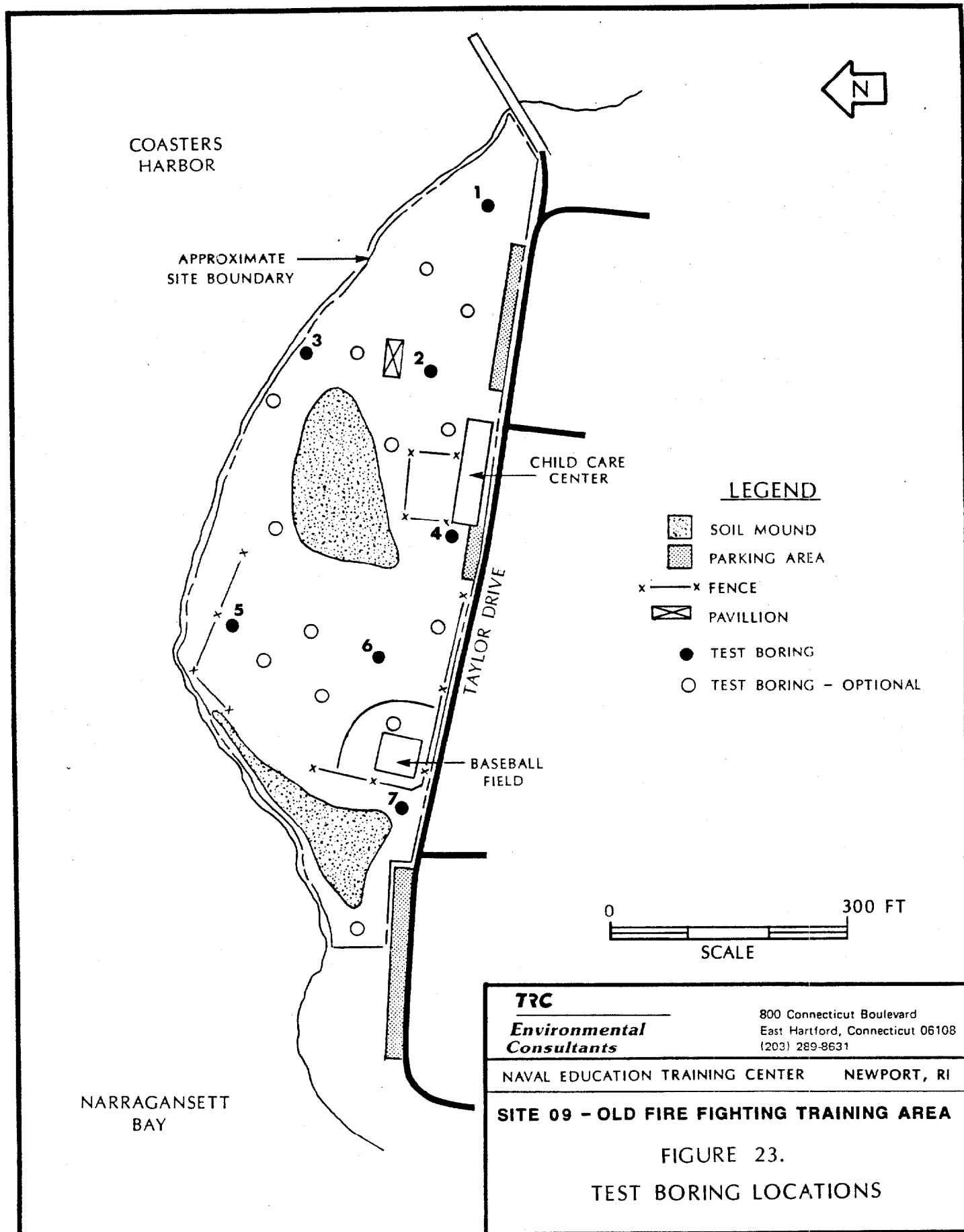
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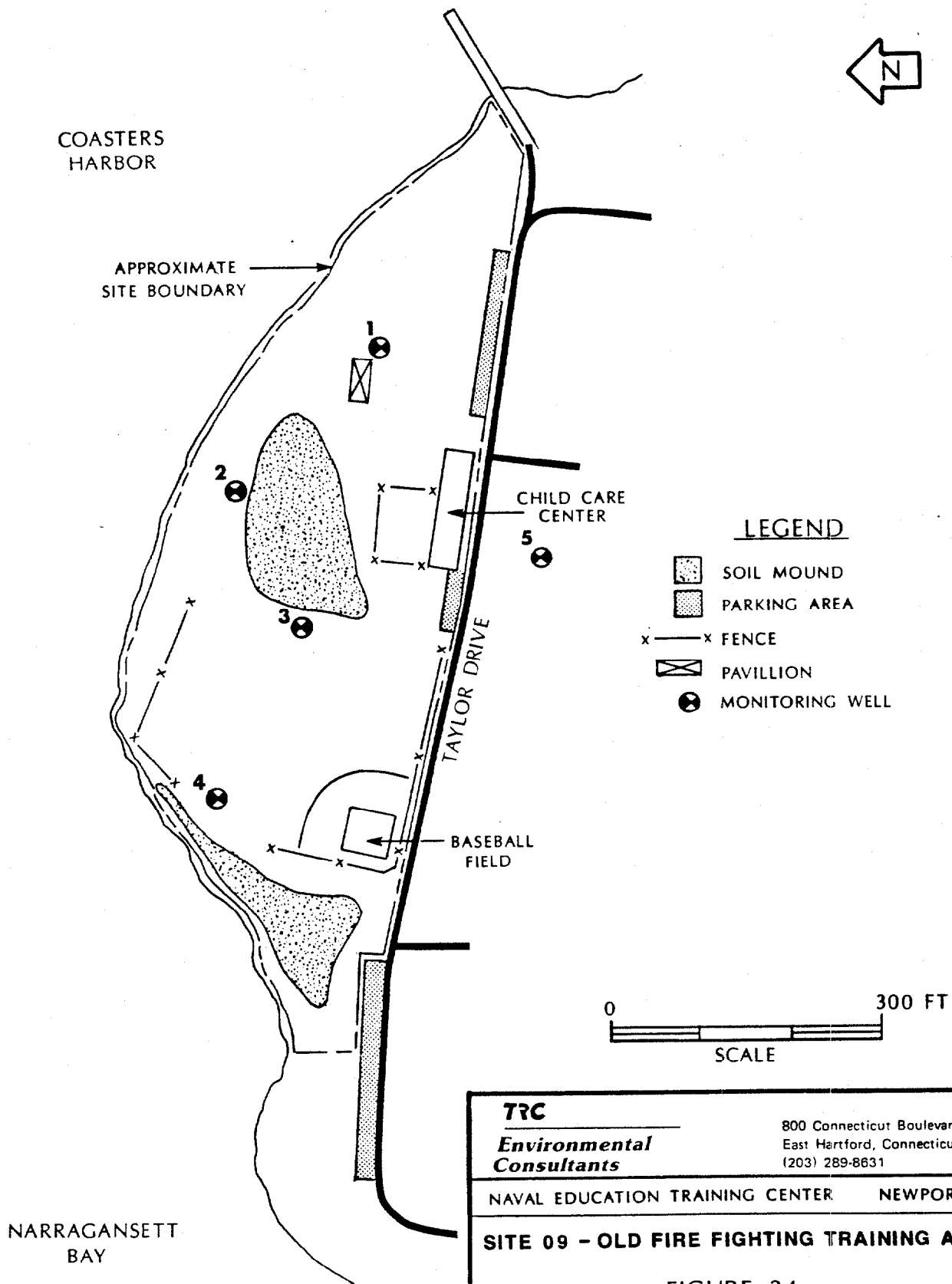
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FIGURE 22.

SURFACE SOIL SAMPLE LOCATIONS





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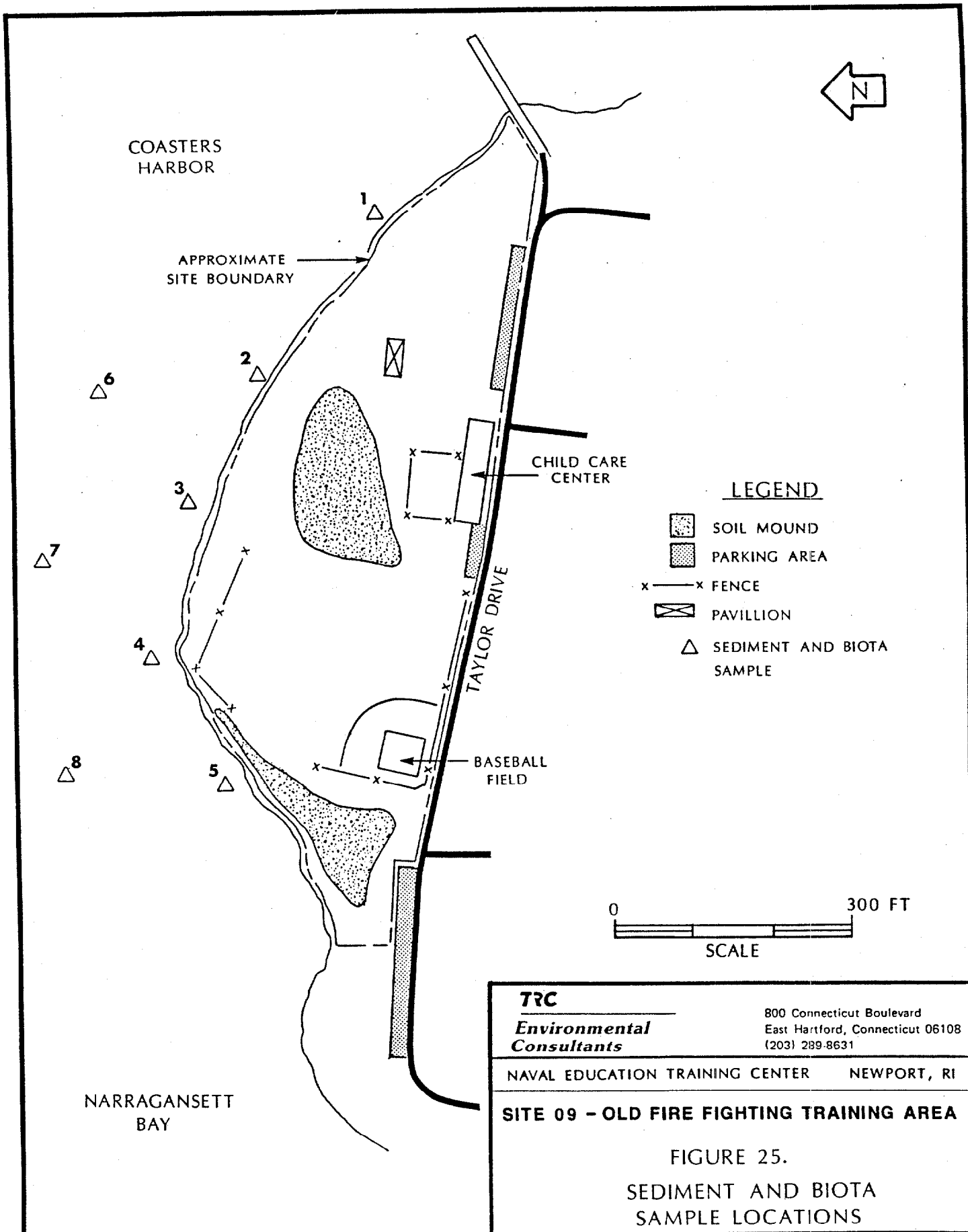
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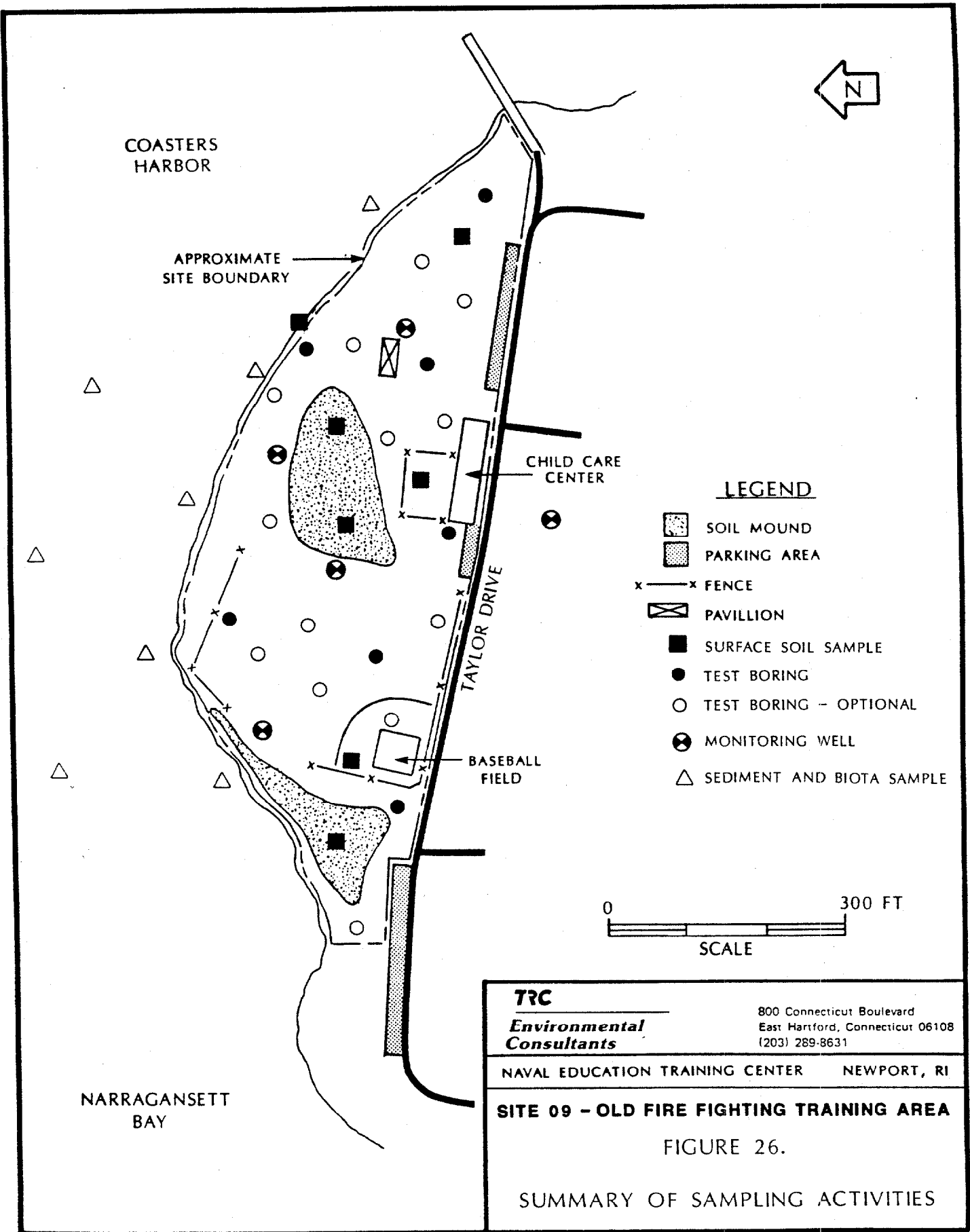
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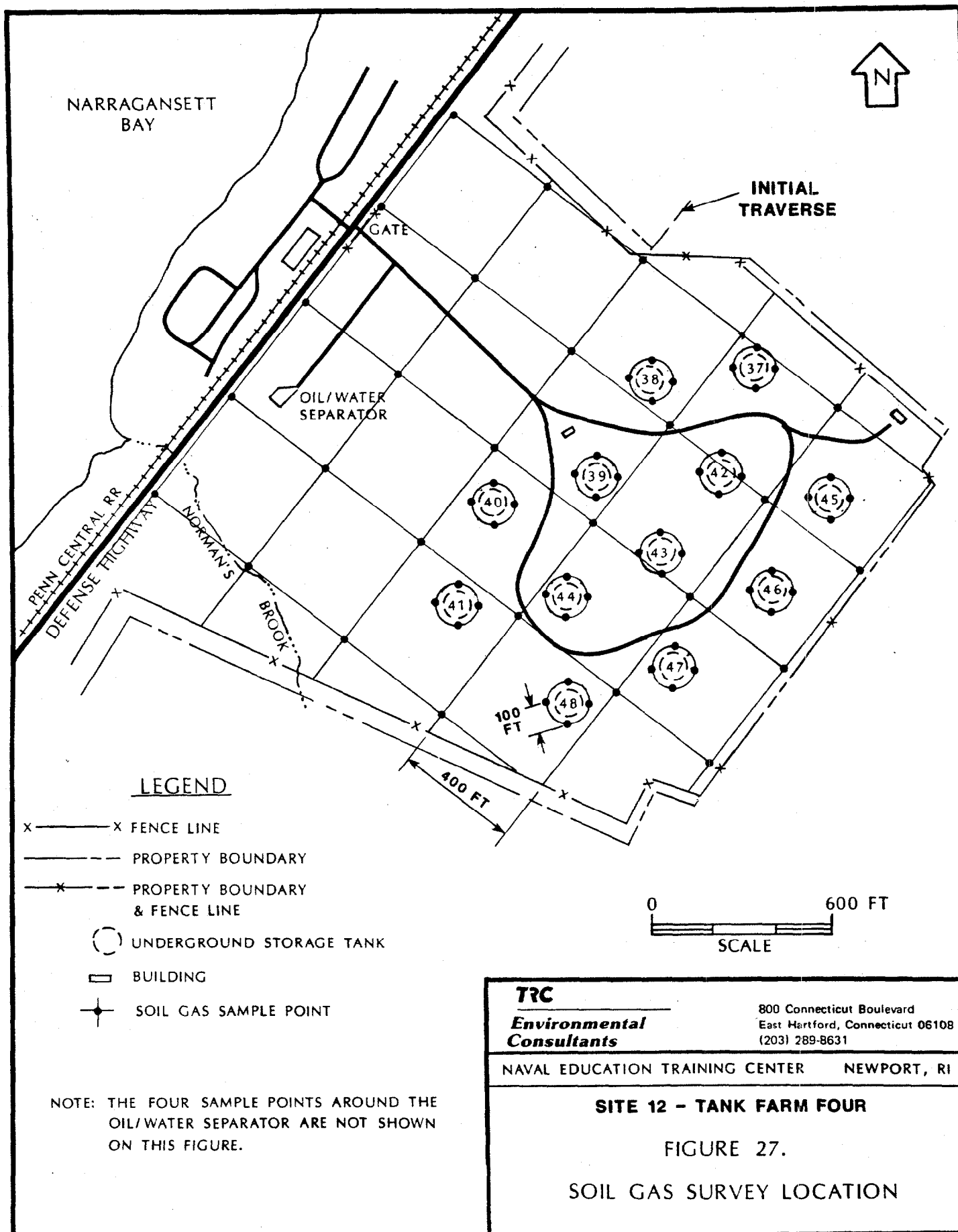
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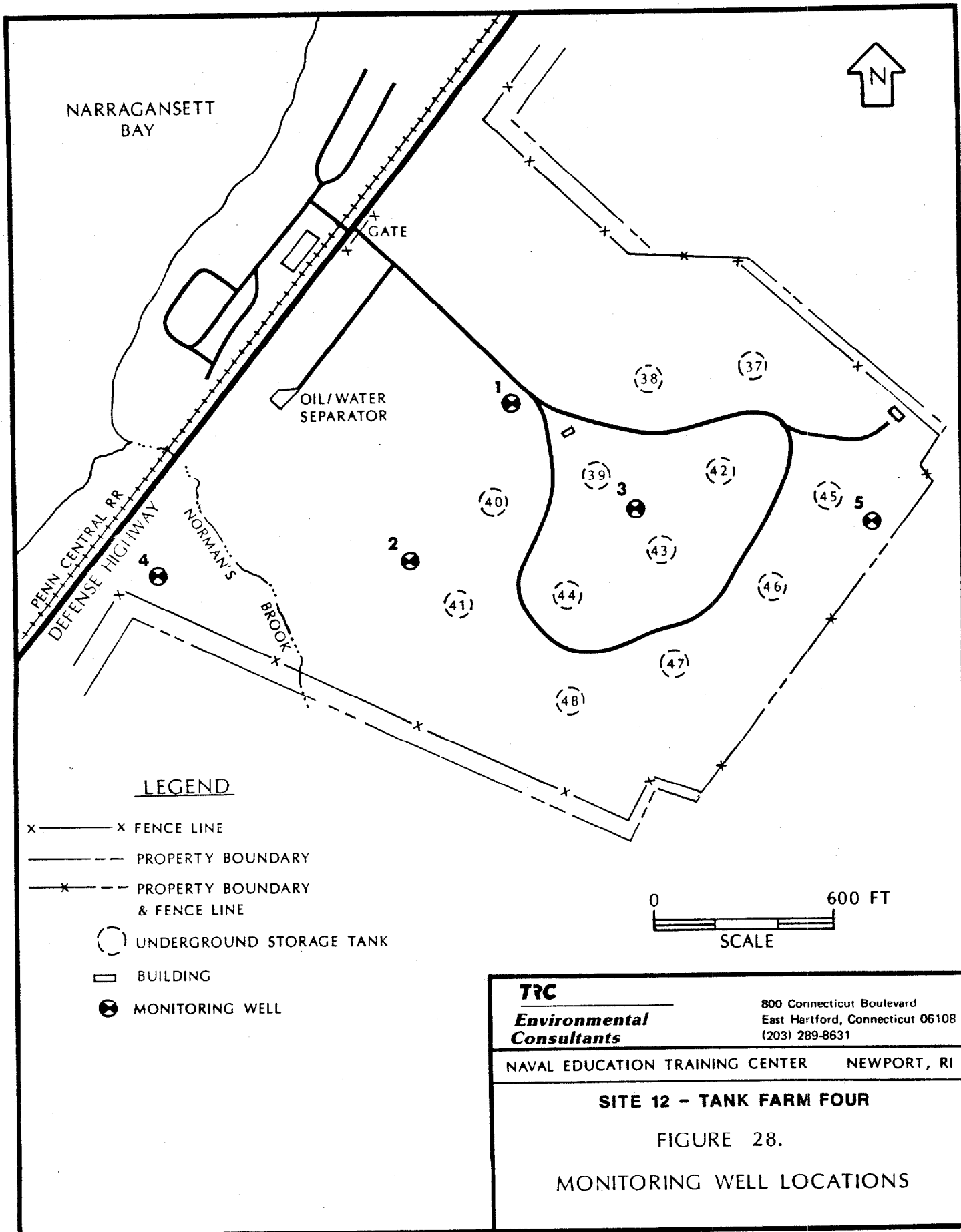
FIGURE 24.

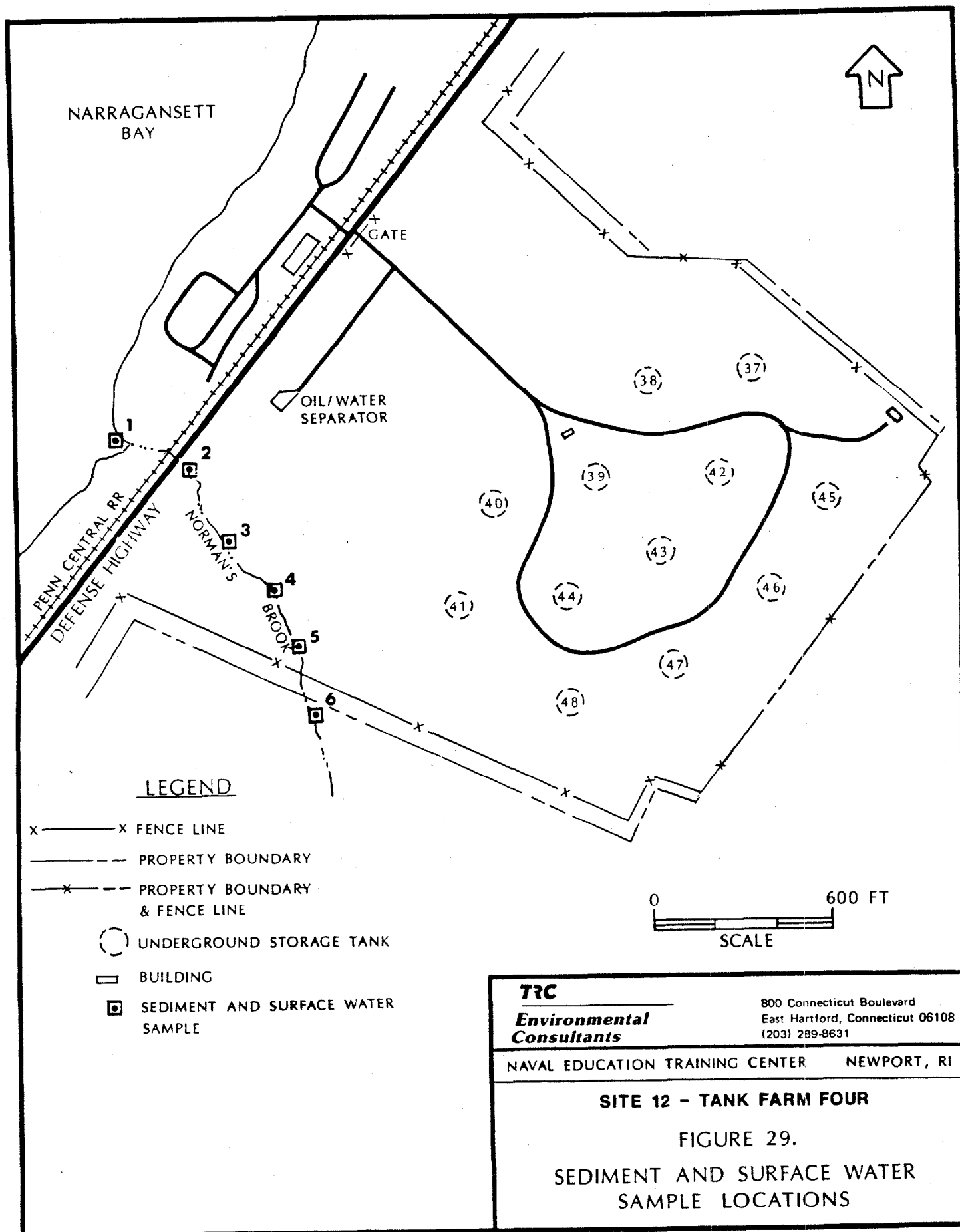
MONITORING WELL LOCATIONS

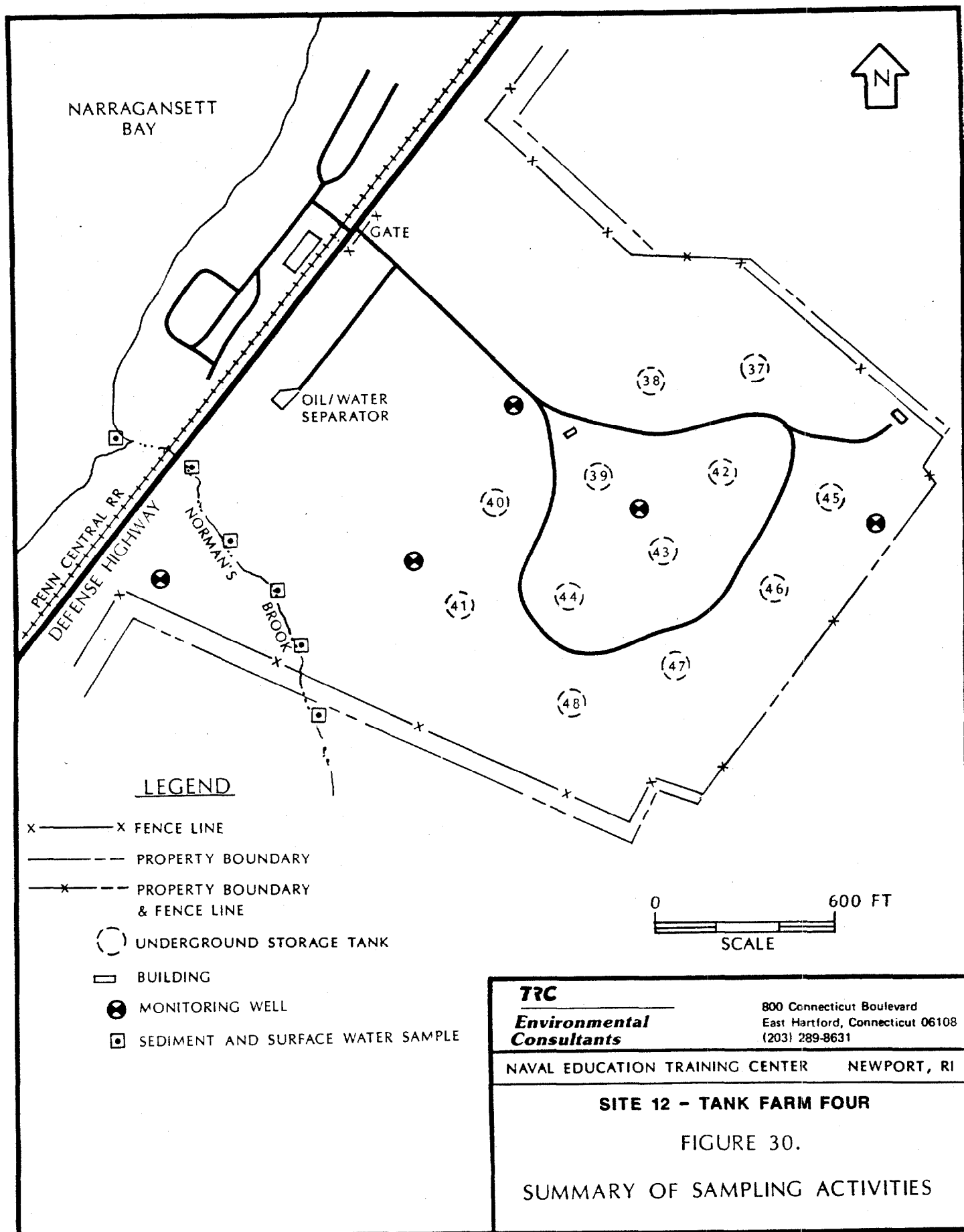


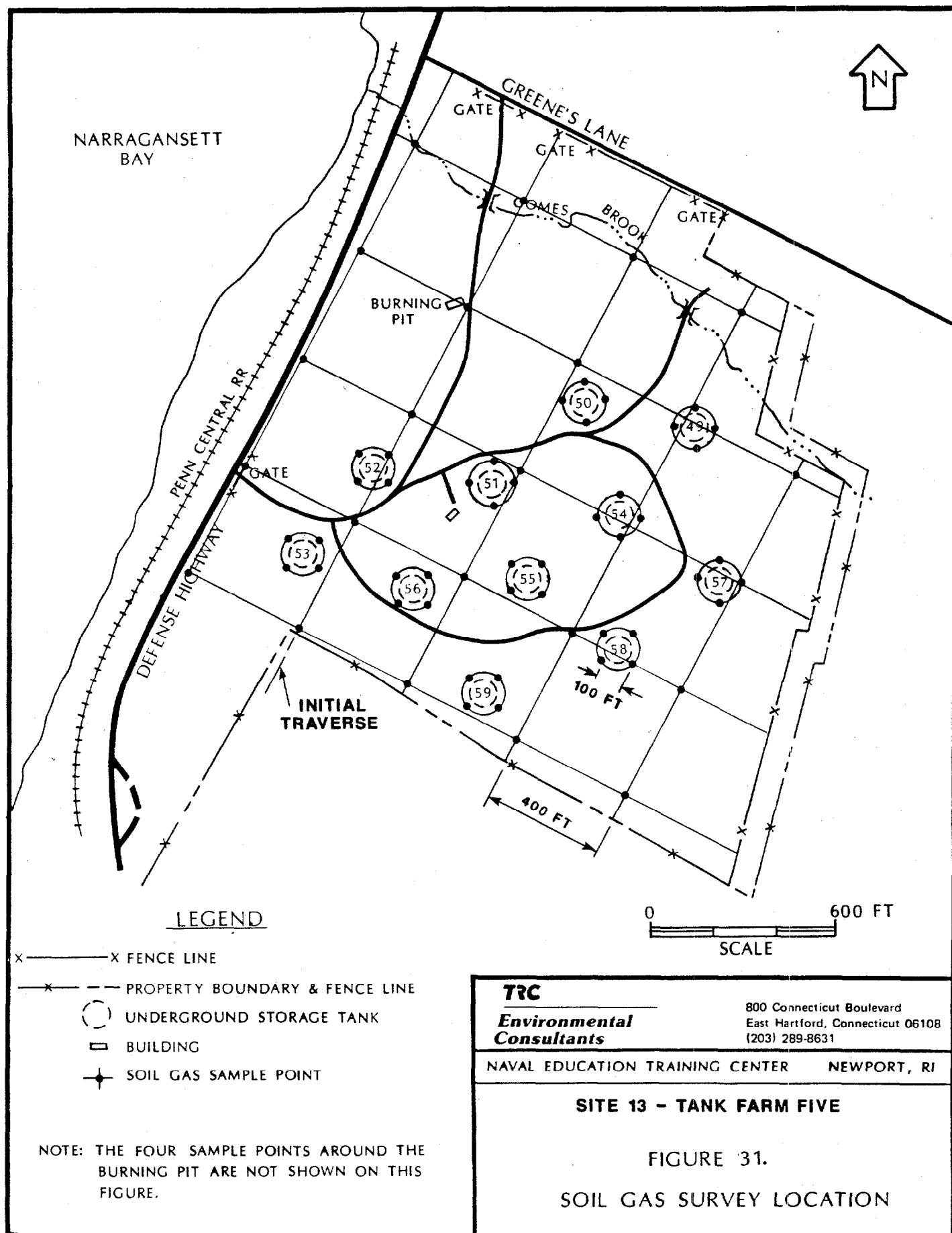


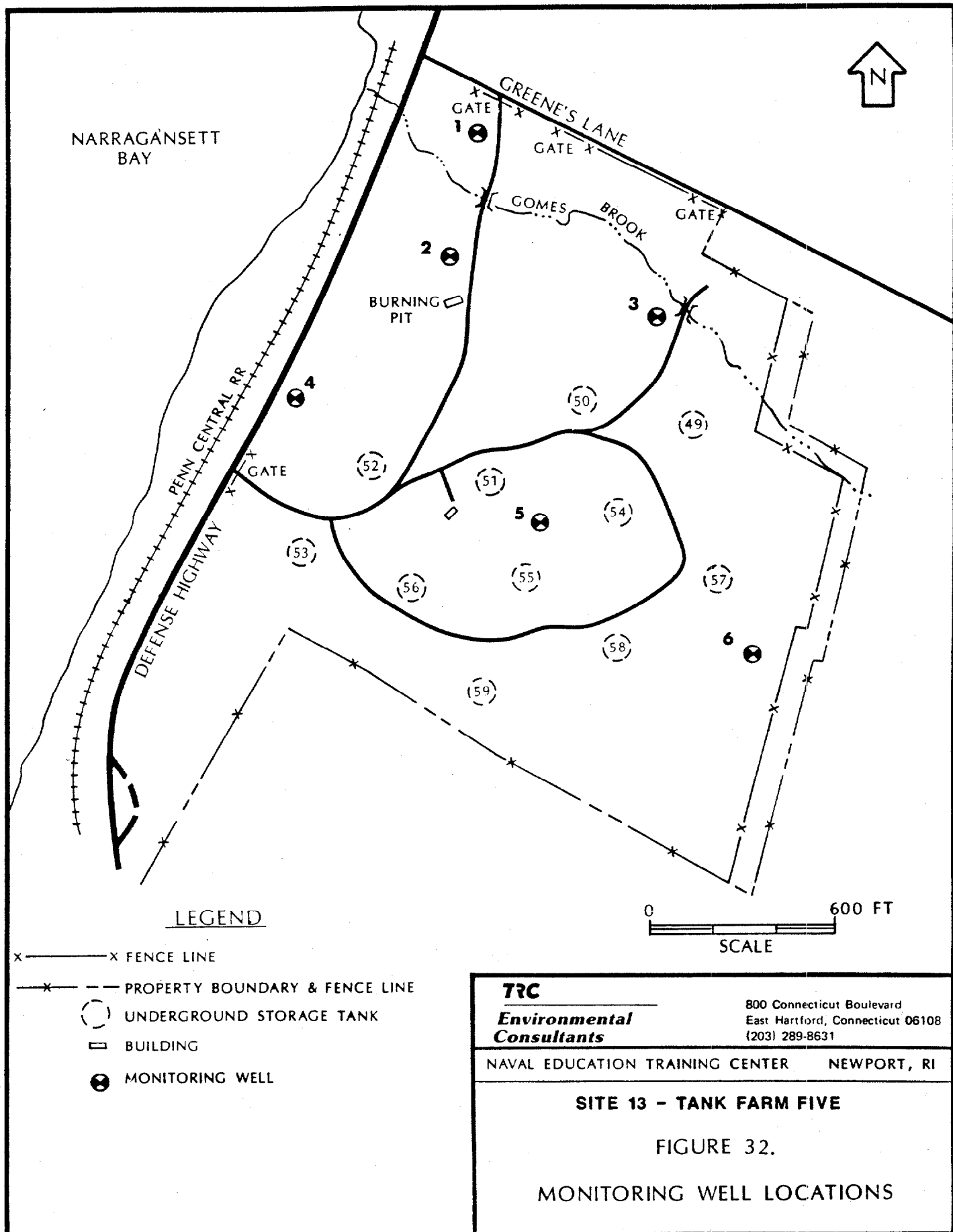


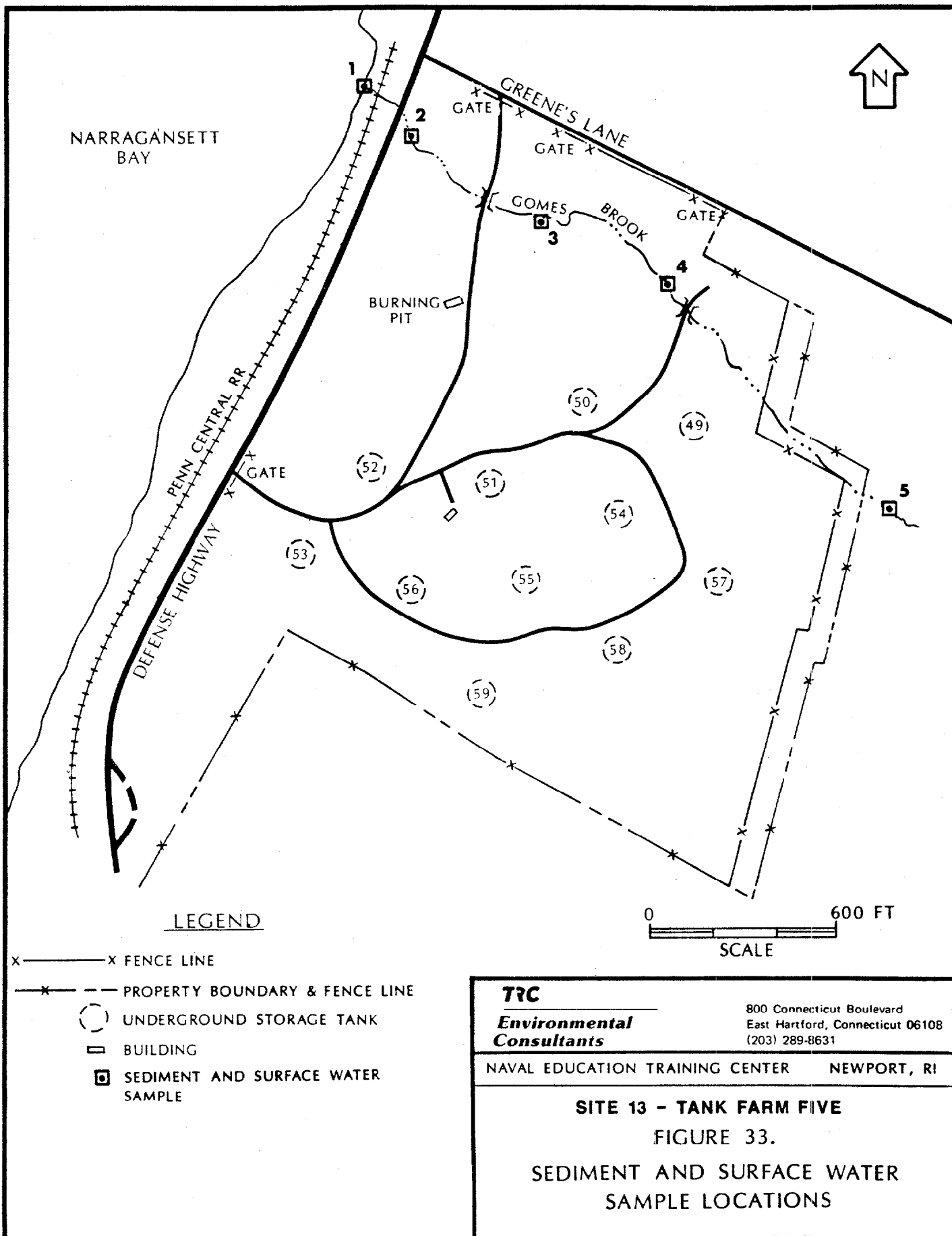


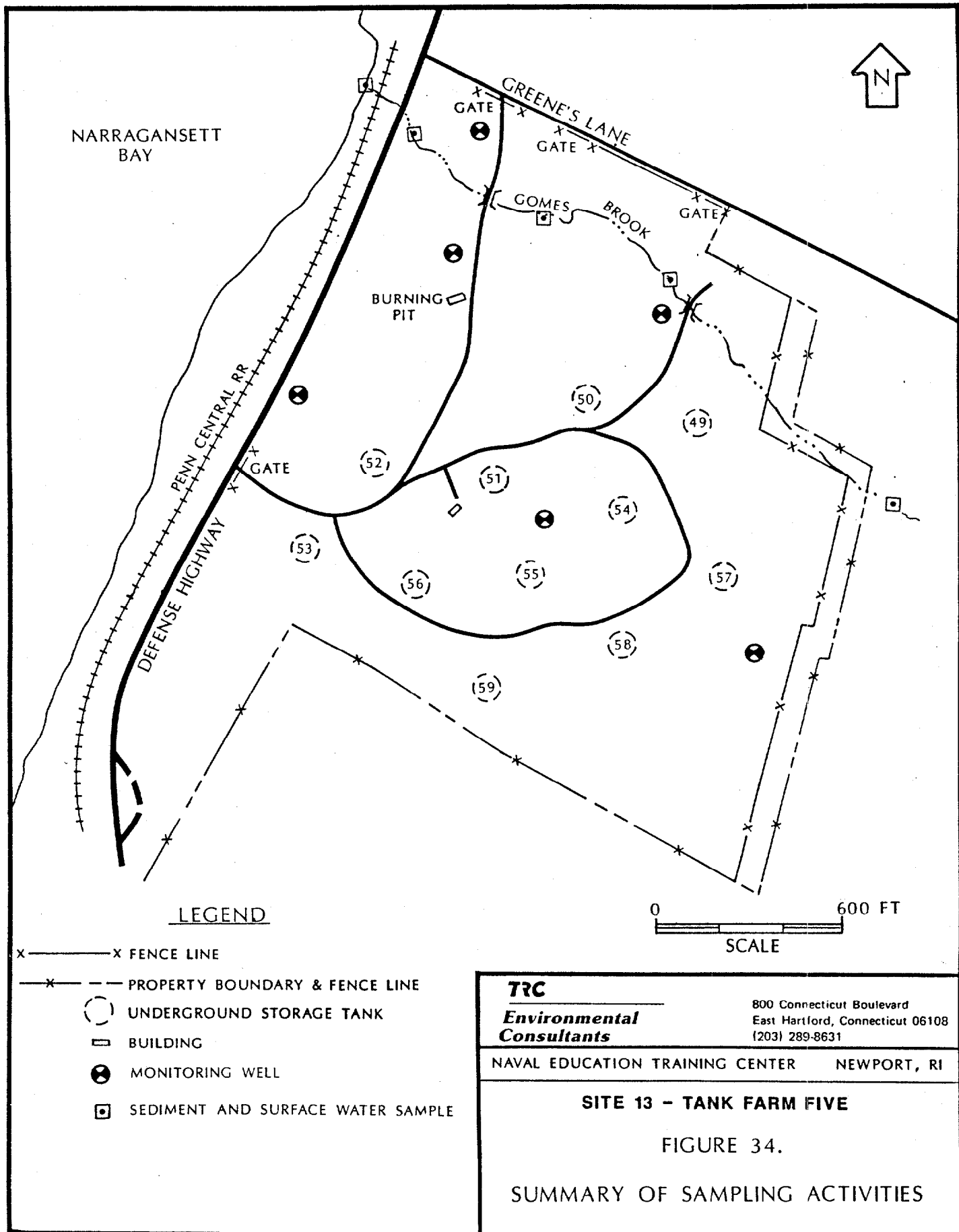


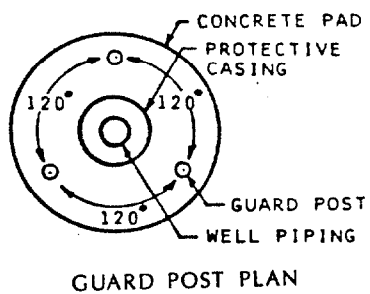
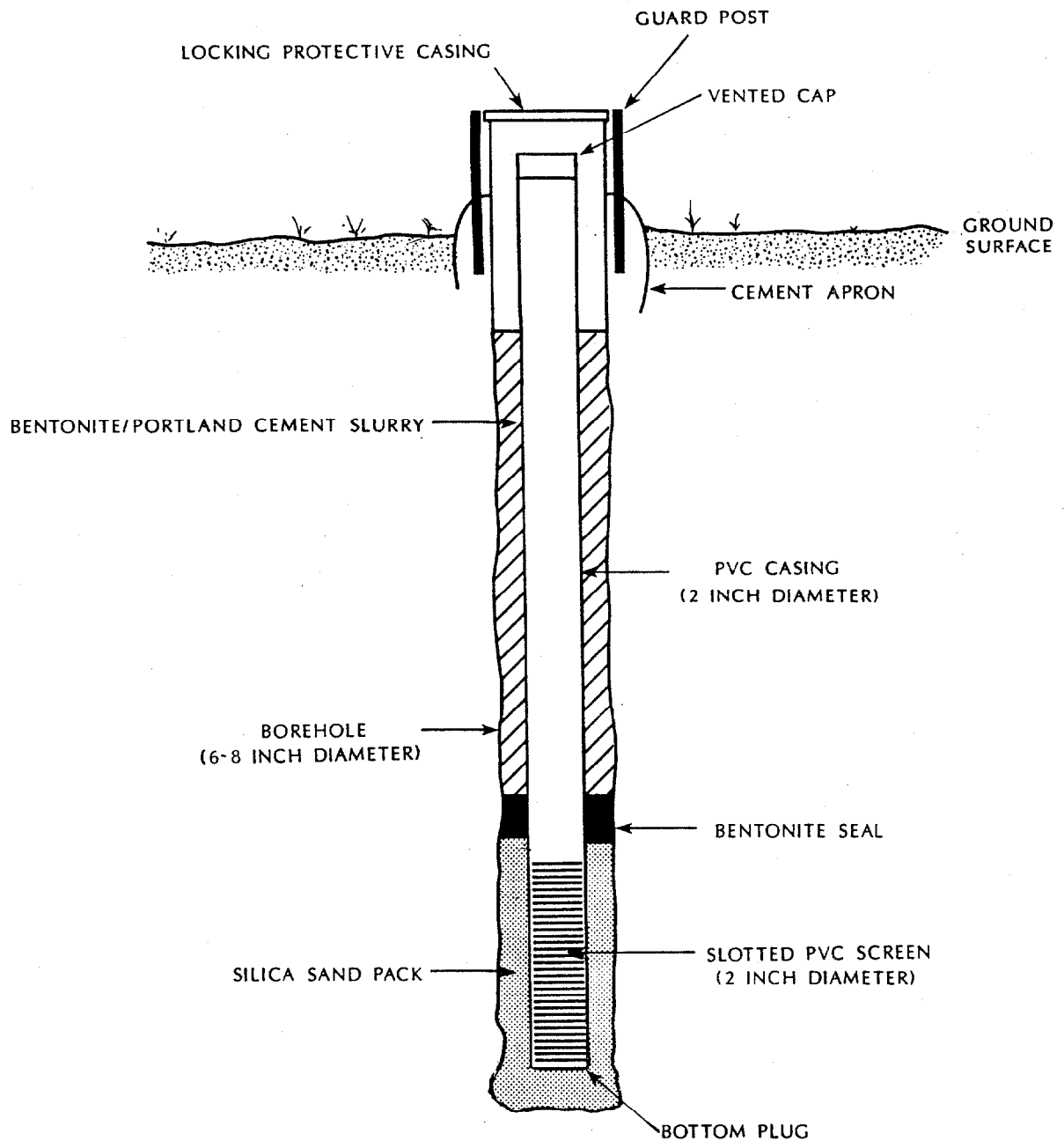












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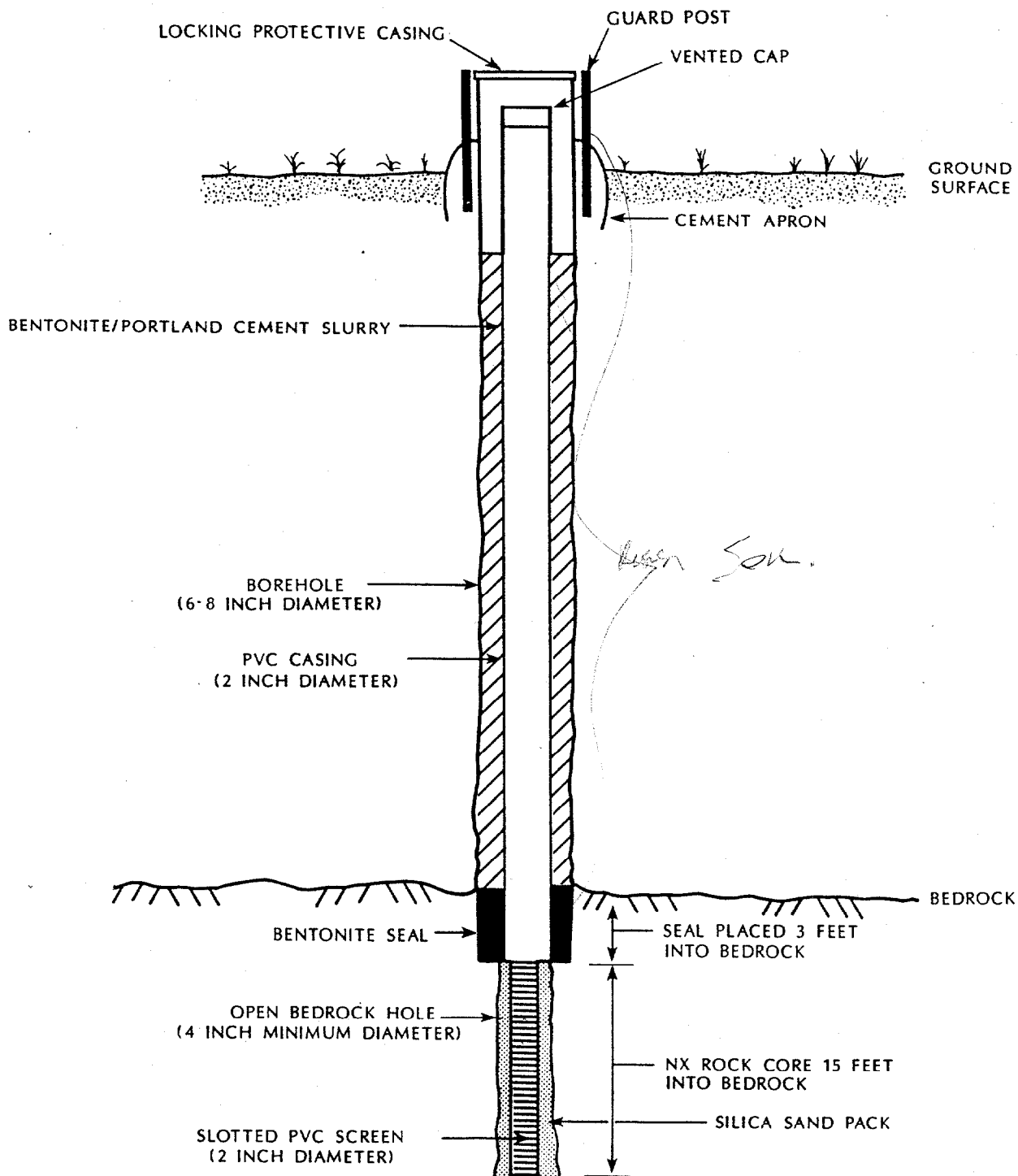
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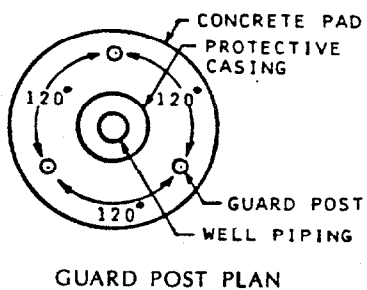
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FIGURE 35.

OVERBURDEN MONITORING WELL
CONSTRUCTION DIAGRAM



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FIGURE 36.
BEDROCK MONITORING WELL
CONSTRUCTION DIAGRAM

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

RI/FS WORK PLAN
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NEWPORT, RHODE ISLAND

Prepared for:

Northern Division - Naval Facilities
Engineering Command
Philadelphia, PA

VOLUME III
QUALITY ASSURANCE/QUALITY CONTROL PLAN

March 1989

TRC Project No. 5383-N81-30
Contract No. N62472-86-C-1282

QUALITY ASSURANCE/QUALITY CONTROL
(QA/QC) PLAN
NAVAL EDUCATION AND TRAINING CENTER (NETC)
NEWPORT, RHODE ISLAND

TRC Environmental Consultants, Inc.
800 Connecticut Boulevard
East Hartford, CT 06108

Approved by:	<u>James Peronto</u> TRC Project Manager	<u>Signature</u>	<u>Date</u>
Approved by:	<u>Richard Londergan</u> TRC QA Officer	<u>Signature</u>	<u>Date</u>
Approved by:	<u>Elizabeth Barrett</u> TRC QA Manager	<u>Signature</u>	<u>Date</u>
Approved by:	<u>James P. Valenti</u> NETC Engineer-in-Charge	<u>Signature</u>	<u>Date</u>
Approved by:	<u>Michael Aucoin</u> Northern Division QA Officer	<u>Signature</u>	<u>Date</u>
Approved by:	<u>Rachel Marino</u> NETC Environmental Coordinator	<u>Signature</u>	<u>Date</u>

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1.0 PROJECT DESCRIPTION

1.1 Introduction

This Quality Assurance/Quality Control Plan (QA/QC) has been developed for use in conjunction with sampling activities at the Naval Education and Training Center (NETC) in Newport, Rhode Island. The sampling program builds on recommendations of previous studies conducted at NETC-Newport under the Navy Assessment and Control of Installation Pollutants (NACIP) program. Previous studies included an Initial Assessment Study (IAS) conducted in 1983, and Confirmation Study completed from 1983-1985.

Current Navy policy calls for the following of EPA guidance and procedures while conducting investigations and remedial actions at all Navy waste sites. The specific tasks outlined in the current Navy Installation Restoration (IR) Program are consistent with EPA guidance, and provide a structure for conducting a Remedial Investigation/Feasibility Study (RI/FS) based on the National Contingency Plan (NCP). The initial planning phase of the Newport RI/FS process includes four scoping tasks under the Navy IR Program, i.e.:

- Task R1 - Description of Current Situation;
- Task R2 - Development of Plans and Management, i.e.,
 - Health and Safety Plan
 - QA/QC and Data Management Plans
 - Field Sampling Plan
- Task E3 -Meetings with Navy and Regulatory Agencies.

These scoping tasks are aimed at achieving six objectives, i.e.:

- Collect and evaluate existing data, including the review of previous investigations;
- Identify study area boundaries;
- Preliminary identification of Applicable or Relevant and Appropriate Requirements (ARARs);
- Identify remedial actions objectives and likely remedial action alternatives;
- Establish data quality objectives; and

- Prepare work plans that address field sampling, QA/QC and health and safety issues.

The field sampling work plan for all media being sampled as part of the remedial investigation study is designed to characterize the nature and extent of contamination, verify the probable contaminant sources, and collect data to evaluate the need for remedial action(s). The sampling program is designed to meet all applicable guidance for Superfund, RCRA, and the Navy IR program.

The QA/QC Plan serves as a controlling mechanism during field sampling to ensure all data collected are valid, reliable, and legally-defensible. The QA/QC Plan outlines the organization, objectives, and all QA/QC activities which will ensure achievement of desired data quality goals.

1.2 NETC Description and History

The Naval Education and Training Center (NETC), Newport, Rhode Island, is located along approximately six miles of the Western Shore of Aquidneck Island and borders Narragansett Bay in Newport County, Rhode Island. The NETC currently occupies 1,063 acres of land.

The NETC serves as both, a training facility, and logistical support facility for the Newport Naval Complex. The Naval history in the Newport area spans from the Civil War era to the present. The Melville area was established in 1900 as a coaling station for naval ships and, subsequently, fuel tanks were added in 1910 as ships converted to liquid fuel. During World War I, additional tanks were constructed in the Melville area. In 1973, the Shore Establishment Realignment Program (SER) resulted in the Navy excessing approximately 1,629 acres of the base's original 2,420 acres.

A detailed description of the NETC base history is presented in the Background Investigation Report provided in Volume I of this Work Plan.

1.3 Previous NETC Site Investigations

Under the NACIP program, an Initial Assessment Study (IAS) for all NETC sites was completed in March 1983. The IAS identified sites where contamination from past waste disposal or handling practices may pose health or environmental risks. The IAS recommended further investigation of 13 sites

at NETC-Newport. Confirmation Study, in accordance with NACIP guidance, was performed from 1983-1985 on six of the 13 sites.

The Confirmation Study represented the second phase of the NACIP program and consisted of two steps: the Verification Step and the Characterization Step. The field activities associated with Confirmation Study included on-site investigations to confirm or deny the presence of contamination at six NETC sites, based on recommendations of the IAS and the Rhode Island Department of Environmental Management (RIDEM). Review of the IAS and Confirmation Study results by the Navy and RIDEM provided a list of sites to be addressed in an RI/FS Work Plan, five of which will be investigated during this RI/FS, including the McAllister Point Landfill, the Melville North Landfill, the Old Fire Fighting Training Area, Tank Farm Four, and Tank Farm Five.

1.4 Current NETC Site Investigations

Remedial investigations will be conducted at five of the NETC sites. The five sites being investigated are the McAllister Point Landfill, Melville North Landfill, Old Fire Fighting Training Area, Tank Farm Four, and Tank Farm Five. Background information on each of these sites is presented in the Background Investigation Report provided in Volume I of this Work Plan. The planned field investigation activities for each site are presented in the Field Sampling Plan provided in Volume II of this Work Plan.

1.5 Project Scope

The objective of this remedial investigation is to develop detailed information on the nature and extent of contamination previously identified in the Initial Assessment Study, Confirmation Study, and/or previous site investigations. The results of the remedial investigation will provide a technically-supported professional judgment as to whether specific site conditions constitute potential environmental, health or safety hazards.

The field activities, sample matrices, and analyses for the five sites being investigated at NETC-Newport will be discussed in this Work Plan. The sample program makes extensive use of Target Compound List (TCL) analyses using EPA-CLP protocols. Naval Energy and Environmental Support Activity (NEESA) guidance for Level C analyses and data validation will be followed (NEESA, 1988) during this program.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Introduction

This project will be largely performed by TRC. Project review will be performed by a Technical Review Committee assembled by the Northern Division. The names and addresses of select individuals involved in the review appear below.

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Northern Division Code 023
Naval Facilities Engineering Command
Philadelphia, PA 19112-5094

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Elizabeth E. Barrett, QA/QC Manager

- Laboratory

To be named, Project Manager

To be named, QC Coordinator

- Rhode Island DEM

Jeffrey P. Crawford, Engineer
(401) 277-2797

- U.S. EPA

To be named.

Figure 1 presents the organization chart for the Newport RI/FS project showing staff positions responsible for each project element. The responsibilities of TRC's Project Manager and QA/QC staff are briefly described below.

2.2 Project Manager's Responsibility

The TRC Project Manager will provide overall direction to the project team, and will be responsible for successful project completion. The Project Manager will be the primary contact for the Northern Division's Engineer-In-Charge (EIC).

2.3 QA Officer's Responsibility

The TRC Corporate QA Officer will be the responsible Quality Assurance Officer for this project. The QA Officer reports independently to the Corporate President and, hence, has full authority to act independently from the technical line management structure. He will serve as TRC's primary contact with the Northern Division's QA staff, if so requested by the EIC. He will monitor compliance of the project with the QA/QC Plan, and perform any necessary performance or system audits.

The TRC QA Officer will initiate and monitor any necessary formal corrective actions. He will assist in preparing QA/QC project summaries for the Final Report, including analysis of precision, accuracy and completeness of data collected.

2.4 Field QC Coordinator - QA/QC Manager's Responsibility

A TRC Field QC Coordinator will be selected for this project. The Field QC Coordinator will work with the field team during preparations for the sampling events, and also during conduct of field work. He or she will be on-site to ensure required QC procedures are followed for sample collection and drilling; will initiate informal and/or formal corrective actions, as necessary; and will maintain and report QC records and results to the TRC Project Manager and QA Officer. The QC field coordinator will also serve as the QA/QC Manager for the project. This person will be responsible for ensuring all analytical deliverables have been received and subsequently validated according to NEESA Level C Data Validation Guidelines.

2.5 Laboratory QC Coordinator's Responsibility

The laboratory selected for this project will also designate a QC Coordinator who will function as part of the project QC team. The exact duties of the laboratory QC Coordinator will include at least the following, in accordance with the NEESA-approved laboratory QA/QC plan:

- Direct preparation of sample containers;
- Direct preparation and inclusion of blind QC samples in sample load in a fashion unrecognizable to analysts;
- Monitor use of known QC samples, blanks and duplicates, as required by specific projects; and
- Maintain records of performance on known and blind QC samples as a measure of analytical precision and accuracy (control charts, etc.).

3.0 SAMPLING PROCEDURES

3.1 Introduction

The following matrices will be collected during the field investigation study at the five NETC-Newport sites: soil, sediment, surface water, biota, tank contents, ground water, and air. All sample collection and monitoring procedures are discussed in the Field Sampling Plan in Volume II of this Work Plan. These procedures will be implemented in order to collect representative data for remedial planning guidance. All sample media collected will be handled in accordance with this Quality Assurance/Quality Control Project Plan, and the "Characterization of Hazardous Waste Sites - a Methods Manual: Volume II. Available Sampling Methods", Second Edition, EPA-600/4-84-076, December 1984. All analytical methods and estimated detection limits are subsequently described in Section 5.0 of this document, including analysis for the Target Compound List (TCL), as well as all other parameters for this project.

3.2 Selection of Sampling Locations

The locations of samples for each of the five sites at NETC-Newport appears in the Field Sampling Plan in Volume II of this Work Plan.

3.3 Sample Collection, Handling and Shipping

During the field sampling program, the appropriate sample containers will be used so that no chemical alteration occurs between the collection of samples in the field, and the receipt of samples at the laboratory. The sample bottle field kit will be prepared and shipped to the field by the laboratory QC Coordinator.

Sample containers will be selected to ensure compatibility with the waste and to minimize breakage during transportation. Aqueous phase samples for organic analyses will be contained in glass vials with teflon-lined, screw-type caps. Sample bottles and preservation required are listed in Tables 1 for soil and sediment samples and Table 2 for aqueous samples. Holding times are further defined in Table 3, based on CLP protocols.

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TABLE 1
CONTAINERS AND PRESERVATION METHODS
FOR SOIL, SEDIMENT, AND WASTE SAMPLES

Number Containers per Sample	Sample Container	Preservation Methods	Analytical Method	Compounds
<u>Organics</u>				
2	40 mL, glass, Teflon®-lined septum cap	Cool, 4°C	SW5030/ SW8010	VOA
2	40 mL, glass, Teflon®-lined septum cap	Cool, 4°C	SW5030/ SW8020	VOA
1	1-250 mL, wide-mouth amber glass, Teflon®-lined cap	Cool, 4°C	CLP SOW	TCL-BNA, P/P
1	250-ml amber wide-mouth	Cool, 4°C	CLP SOW	2,3,7,8-TCDD
<u>Inorganics</u>				
1	250 mL, wide-mouth amber glass	--	ICP-CLP SOW	Total metals: Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn, Cn

VOA = Volatile Organic Analyses.

TCL = Target Compound List.

BNA = Base/Neutral and Acid Extractable Analyses.

P/P = Pesticide/PCB Analyses.

CLP SOW = Contract Laboratory Program - Statement of Work.

TABLE 2

CONTAINERS AND PRESERVATION METHODS FOR AQUEOUS SAMPLES

Number Containers per Sample	Sample Container	Preservation Methods	Analytical Method	Compounds
<u>Organics</u>				
2	40 mL, glass, Teflon®-lined septum cap	Cool, 4°C HCl (4 drops)	CLP SOW ^a	TCL-VOA
2	40 mL, glass, Teflon®-lined septum cap	Cool, 4°C	SW5030/ SW8010	VOA
2	40 mL, glass, Teflon®-lined septum cap	Cool, 4°C HCl (4 drops)	SW5030/ SW8020	VOA
1	1-gal, narrow-mouth amber glass, Teflon®-lined cap	Cool, 4°C	CLP SOW ^a	TCL-BNA, P/P
2	40 mL, glass, Teflon®-lined septum cap	Cool, 4°C	EPA 502.1	1,2-Dibromo- methane
1	1-gal, narrow-mouth amber glass, Teflon®-lined lid	Cool, 4°C	SW8150	Chlorinated herbicides
2	40 mL, glass, Teflon®-lined septum cap	Cool, 4°C	SW8015	Nonhalogenated volatile organics
2	1 L, glass, Teflon®-lined lid	Cool, 4°C HCl (5 mL)	EPA 418.1	Petroleum hydrocarbons
<u>Inorganics</u>				
1	500 mL, polyethylene	HNO ₃ to pH <2	ICP-CLP SOW	Total metals: Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn
1	500 mL, polyethylene	Cool, 4°C	A429 EPA 160.1	Phosphate TDS
1	1 L, polyethylene	Cool, 4°C NaOH to pH >12 ^b	CLP SOW	CN

(Continued)

TABLE 2
CONTAINERS AND PRESERVATION METHODS FOR AQUEOUS SAMPLES
(Continued)

Number Containers per Sample	Sample Container	Preservation Methods	Analytical Method	Compounds
<u>Inorganics</u> (Continued)				
1	1 L, polyethylene	Cool, 4°C HNO ₃ to pH <2	ICP-CLP SOW	Total metals: Al, Sb, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Mg, Mn, Ni, K, Ag, Na, V, Zn
		Cool, 4°C	CLP SOW	As, Se, Tl
1	1 L, polyethylene	Cool, 4°C 4 mL zinc acetate and NaOH to pH >9	EPA 376.1	Sulfide
1	1 L, polyethylene	Cool, 4°C H ₂ SO ₄ to pH <2	EPA 350.3 EPA 351.3	Ammonia N TKN
1	500 mL, polyethylene	Cool, 4°C	EPA 160.1	TDS

^a One in 20 samples will be collected in triplicate for matrix spike and matrix spike duplicate analyses in accordance with CLP protocols.

^b Water samples to be analyzed for cyanide will be checked in the field for the presence of chlorine using potassium iodidex (KI) starch paper. If chlorine is present, ascorbic acid will be added until the KI paper indicates that no chlorine is present.

TCL = Target Compound List.

VOA = Volatile Organic Analyses.

BNA = Base/Neutral and Acid Extractable Compounds.

P/P = Pesticides/PCB Analyses.

TCDD = Tetrachlorodibenzo-p-dioxin.

CLP SOW = Contract Laboratory Program - Statement of Work.

EPA = U.S. Environmental Protection Agency.

TDS = Total Dissolved Solids.

TKN = Total Kjeldahl Nitrogen.

TABLE 3
HOLDINGS TIMES FOR SOIL, SEDIMENT, AQUEOUS
AND WASTE SAMPLES

Parameter	CLP Holding Time for Samples	
	Aqueous	Soil/Sediment/Waste
TCL Volatile Organic Compounds	10 days from VTSR	10 days from VTSR
TCL Base Neutral/Acid and Extractable Compounds	5 days to extraction from VTSR; 40 days from extraction	10 days extraction from VTSR; 40 days from extraction
TCL Pesticide/PCB Compounds	5 days to extraction; 40 days from extraction	5 days to extraction; 40 days from extraction
Petroleum Hydrocarbons (EPA Method 418.1)	NA	NA
TCL Metals and Inorganic Compounds	6 months; except Hg - 26 days	6 months; except Hg - 26 days
2,3,7,8-TCDD	NA	NA

NA = Not applicable; no holding times established according to the CLP SOW.

VTSR = Verified Time of Sample Receipt.

Each sample label will be filled out at the time of sampling by TRC field sampling personnel according to the proper chain-of-custody procedures and will be affixed to each container to identify the sample number, collector's name, date and time of sample collection, location of the sampling point, and addition of any sample preservatives.

Ground water samples will be analyzed for total metals and consequently, filtering will not be conducted in the field prior to the addition of preservatives. Water samples to be analyzed for cyanide will be checked in the field for the presence of chlorine using potassium iodide (KI) starch paper. If chlorine is present, ascorbic acid will be added until the KI paper indicates that no chlorine is present.

After the bottles for a given sample have been filled, they will subsequently be placed in a shipping cooler. Samples requiring preservation at 4°C will be covered with crushed ice in plastic bags or ice packs and placed in a separate cooler. Field personnel will provide crushed ice or ice packs to add to the shipping coolers as the samples are collected. Each sample container will be cushioned and sealed in a cooler container for shipment to the laboratory by an overnight carrier service. Daily sample collection activities will be scheduled in order to assure overnight shipment by the designated carrier.

The chain-of-custody record will accompany all samples to provide documentation of all samples collected and to trace sample possession. Chain-of-custody procedures are discussed in detail in Section 4.0 of this document.

After all the sample containers have been filled and properly stored, field testing will be performed. Three parameters will be measured in the field for all aqueous samples: pH, temperature, and conductivity. These measurements will be taken from a separate container which will not be submitted to the laboratory for analysis. Temperature will be measured immediately upon collection of all ground water, surface water and tank water samples, as it is subject to the most rapid change. Conductivity and pH will be measured with electronic probes, which will be decontaminated with organic-free distilled water in between each usage.

3.4 Field Quality Control (QC) Samples

Table 4 lists the percentage of field QC samples per sample matrix for the Level C analyses, based on current Navy (NEESA) guidance. A sampling event is defined as the time from which the sampling personnel arrive at the site until these personnel complete the sampling task. An example of two events would occur if sampling personnel went to a site for 3 weeks, drilled borings, and installed monitoring wells. During this task, soil and water samples were collected for laboratory analysis. The sampling crew subsequently left the site for two months, thus concluding the first sampling event. The crew later returned to collect another set of ground water samples over a 3-day period. The second visit would constitute the second sampling event.

Trip blanks, field blanks, duplicate samples, and reference samples will be collected as part of each sampling event, in order to ascertain a measure of quality control during each sampling round. The following sections described the purpose and usage of each of these types of samples.

3.4.1 Trip Blanks

Trip blanks are defined as samples which originate from analyte-free water which is placed in volatile organic vials in the laboratory and shipped to the site with the field sampling kit. These vials are subsequently returned to the laboratory with the volatile organic (VOA) samples. One trip blank will accompany each cooler containing samples to be analyzed for VOAs, and will be stored at the laboratory with the samples. Trip blanks will be analyzed in order to evaluate the effect of ambient site conditions and sample shipment on sample integrity, and to ensure proper sample container preparation and handling techniques. All trip blanks will be labeled according to the proper chain-of-custody procedures and will be analyzed for volatile organic compounds.

3.4.2 Field Blanks

Field blanks will be collected in order to determine the effectiveness of the decontamination of sample collection equipment. The field blank will be collected by pouring laboratory-supplied, analyte-free deionized water directly over the decontaminated sample collection equipment (i.e., bailer, stainless steel spoon, etc.) and into the appropriate sample containers.

TABLE 4
FIELD QC SAMPLES PER SAMPLING EVENT
(NEESA GUIDANCE FOR LEVEL C)

Type of Sample	Level C	
	Metal	Organic
Trip blank (for volatiles only)	NA ^a	1/cooler
Field blank	1/20 per matrix or 1/matrix/event for all analytes, whichever is greater	
Source blank	1/each source of water	
Field duplicates ^c	10%	10%
Refereee duplicate ^c	AN ^b	AN ^b

^a NA - Not applicable.

^b AN - As needed.

^c All field duplicates will be submitted as "blind" duplicates for quality control determinations.

Field blanks will be collected for each matrix sampled, all field blanks will be analyzed for the corresponding TCL parameters pertaining to the sample matrix. A minimum of one in 20 samples will have a field blank collected or a minimum of one field blank per day per matrix will be collected. All field blanks will be labeled according to the proper chain-of-custody procedures, stored and shipped according to the procedures discussed previously.

3.4.3 Source Water Blanks

Source water blanks consist of the source water used during decontamination (e.g., steam cleaning). At a minimum, one source blank from each source of water will be collected and analyzed for the same parameters as the related samples.

3.4.4 Field Duplicates

Duplicate samples will be collected, homogenized, and split. Samples for volatile organic compound analyses will not be mixed, but equal portions of the sample will be collected simultaneously and placed in 40-mL glass vials. Field duplicates will be collected at a frequency of 10 percent per sample matrix (NEESA - Level C). All duplicate samples will be sent to the primary laboratory responsible for analysis.

3.4.5. Referee Duplicates

Duplicates shall be sent to the referee QA laboratory if regulators (state or federal) collect split samples or if a special problem occurs in sample analysis or collection. These referee duplicates/splits are collected and analyzed in addition to the field duplicates mentioned in the previous paragraph.

3.5 Field Decontamination Procedures

Drill rigs and drilling equipment shall be decontaminated prior to moving to a site. Drilling equipment used for multiple boreholes will be decontaminated prior to each boring at the site. All decontamination of drill rigs and drilling equipment (e.g., augers, rods) will be conducted at designated decontamination areas with a steam cleaner. Decontamination of sampling equipment will be performed at each site. Sampling equipment such as split-spoons, stainless steel spoons or spatulas, and stainless steel mixing pans will be decontaminated using the following procedures:

- Wash and scrub with low phosphate detergent in tap water;
- Rinse with tap water;
- Rinse with 10% nitric acid (1% nitric acid on carbon steel split-spoons);
- Rinse with tap water;
- Rinse with hexane and methanol - pesticide grade solvents or better;
- Rinse with distilled water (demonstrated to be analyte-free);
- Air dry - on clean polyethylene sheeting; and
- Wrap in aluminum foil, shiny side out for transport (if not being used immediately).

NOTE: Clean equipment may rest on -- but never be wrapped in clean polyethylene sheeting.

A drilling sequence hierarchy (from less likely to more likely contaminated boring locations) will be imposed to reduce the potential for cross-contamination. All sampling equipment will be decontaminated prior to use at each sampling location. All decontamination rinsates will be collected and contained in drums for later determination of proper handling and/or disposal.

4.0 SAMPLE CUSTODY

4.1 Introduction

Sample custody procedures will be observed to ensure the validity of the data generated during this program. Sample chain-of-custody will be initiated with selection and preparation of the sample containers. To reduce the chance for error, the number of personnel handling samples will be restricted, and one person will be assigned the responsibility of field sample custodian.

On-site monitoring data will be controlled and entered daily in permanent log books, as appropriate. Personnel involved with the sample chain-of-custody process will be trained in sample collection and handling procedures prior to project initiation.

4.2 Field Sample Custody

Sample custody and documentation procedures described in this section will be followed throughout all sample collection activities at NETC-Newport. Components of sample custody procedures include the use of field log books, sample labels, and chain-of-custody forms.

4.2.1 Field Notebooks

The TRC project manager will control all field notebooks. Each field notebook will receive a serialized number and be issued to the field team leader. Field notebooks will be bound books, preferably with consecutively numbered pages that are at least 4-½ inches x 7 inches in size. Field notebooks will be maintained by the TRC field team leader and other team members to provide a daily record of significant events, observations, and measurements during the field investigation. All notebook entries will be signed and dated.

All information pertinent to the field survey and/or sampling will be recorded in the notebooks. Field notebook entries will include the following information (at a minimum):

- Name and address of field contact;
- Name and title of author, date and time of entry, and physical/environmental conditions during field activity;

- Names and titles of field crew;
- Names and titles of any site visitors;
- Type of sampling activity;
- Location of sampling activity;
- Description of sampling point(s);
- Date and time of sample collection;
- Sample media (e.g., soil, sediment, ground water, etc.);
- Sample collection method;
- Number and volume of sample(s) taken;
- Sample preservatives;
- Sample identification number(s);
- Sample distribution (e.g., laboratory);
- Field observations;
- Any field measurements made such as pH, temperature, conductivity, water level, etc.;
- References for all maps and photographs of the sampling site(s); and
- Sample documentation such as:
 - bottle lot numbers,
 - dates and method of sample shipments, and
 - chain-of-custody records.

All original data recorded in either the field notebooks, on sample tags, or in the chain-of-custody records will be written with waterproof ink. None of these accountable serialized documents will be destroyed or discarded, even if they are illegible or contain inaccuracies.

If an error is made on an accountable document assigned to an individual, that individual will make all corrections by crossing a line through the error and entering the correct information and initialing the cross-out. The erroneous information will not be obliterated. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry, and will be initialed and dated, as appropriate.

4.2.2 Sample Labels

All samples obtained at the site will be placed in an appropriate sample container for preservation prior to shipment to the laboratory. Each sample will be individually identified with a separate identification label recorded with a unique sample identifier. The information recorded on the label will include:

- Project name/project number/location;
- Sample identifier/number;
- Source/location of sample;
- Analysis to be performed;
- Preservatives used, especially any non-standard types, and any other field preparation of the sample;
- Date of collection;
- Time of collection (a four-digit number indicating the 24-hour (military) clock time of collection; e.g., 1430 for 2:30 p.m.);
- Number of containers per analyte (i.e., 1 of 2, etc.); and
- Sampler's initials.

Examples of TRC's proposed sample identification labeling format for each sample type are presented in the project Field Sampling Plan.

4.2.3 Custody Seals

Samples will be placed in containers sealed with custody seals prior to shipment to the laboratory. Clear adhesive tape will be placed over the seals to ensure that seals are not accidentally broken during shipment.

4.2.4 Chain-of-Custody Records

All samples will be accompanied by a chain-of-custody record, an example of which is shown on Figure 2. A chain-of-custody record will accompany the sample from initial sample container selection and preparation commencing at the laboratory, to the field for sample containment and preservation, and through its return to the laboratory. If samples are split and sent to different laboratories, a copy of the chain-of-custody record will be sent with each sample.

The "Remarks" column in the chain-of-custody record will be used to record specific considerations associated with sample acquisition such as: sample type, container type, and sample preservation methods. When transferring samples, the individuals relinquishing and assuming sample custody will sign, date, and note the transfer time on the record.

Two copies of the chain-of-custody record will follow each sample to the laboratory. The laboratory will maintain one file copy, and the completed original will be returned to the TRC field team leader. A copy of the completed original will be returned as a part of the final analytical report. This record will be used to document sample custody transfer from the sampler, to another TRC team member, to a shipper, or to the laboratory, and also to verify the date of sample receipt in the laboratory.

Shipments will be sent by overnight carrier with appropriate bill of lading documentation. Bills of lading will be retained as part of the permanent program documentation.

4.2.5 Sample Shipment

Samples will be delivered to the primary laboratory and an alternate laboratory (if split) for analysis as soon as practical after the number of samples and sample containers is sufficient to comprise a shipment, preferably the same day the samples are collected. Sample shipment will occur at a minimum frequency of every other day. The samples will be accompanied by the chain-of-custody record. During sampling and sample shipment activities, the TRC field team leader (or his designee) will contact the laboratory daily to provide information about impending shipments.

4.2.6 Sample Master Log Notebook

In addition to the field notebook documentation, all samples will be documented in a master sample log notebook for future reference. This master sample log will include the following information: sample identifier, sampling date and time (military), sampling personnel, matrix type (i.e., soil), containers/parameters for analysis, date and method of shipment, any sample preservation, and any other pertinent information relating to the sample(s). The master sample log will be consistently updated during sampling

activities in the field for review during site visit audits by Navy, EPA, or RIDEM personnel. Upon completion of sampling activities, the master sample log notebook will be delivered to the TRC Project Manager.

4.3 Laboratory Sample Custody

The TRC field team leader will notify the laboratory of upcoming field sampling activities and subsequent sample transfer to the laboratory. This notification will include information concerning the number and type of samples to be shipped, as well as the anticipated sample arrival date.

The laboratory will designate a sample custodian who will be responsible for maintaining sample custody and for maintaining all associated custodial documentation records. After receiving the samples, the sample custodian will check the original chain-of-custody record and request for analysis documents against the labeled contents of each sample container for correctness and traceability. The sample custodian will then sign the chain-of-custody record and record the date and time that the sample shipment was received at the laboratory. The samples will then be logged into the laboratory system.

Care will be exercised in the laboratory to annotate any labeling or descriptive errors associated with the sample containers. In the event of discrepant documentation, the laboratory will immediately contact the TRC field team leader as part of the corrective action process. A qualitative assessment of each sample container will be performed to note any anomalies, such as broken or leaking bottles. This assessment will be recorded as part of the incoming chain-of-custody procedure.

Samples will be stored in a secured area and at a temperature of approximately 4°C, if necessary, until analyses are performed. A laboratory chain-of-custody record will accompany the sample or sample fraction through final analysis for sample control. A copy of the chain-of-custody record will accompany the laboratory's analytical report and will become a permanent part of the project's records. The pH of incoming water samples will be checked by the laboratory when preservatives have been added to the sample. Details of the chain-of-custody for laboratory activities will be provided in the laboratory's QA manual.

4.4 Evidence File

The TRC project manager will serve as file custodian. At the project's completion, the files will be returned to the Navy's Northern Division Office where they will be permanently archived.

The evidence file will contain all incoming materials related to the project such as: sketches, correspondence, authorizations, and logs. These documents will be placed in the project file as soon as possible. If correspondence is needed for reference by project personnel, a copy will be made rather than manipulating the original. All records shall be legible and easily identifiable.

Examples of the types of records that will be maintained in the project file are:

- Field documents;
- Correspondence;
- Photographs;
- Laboratory data;
- Reports; and
- Procurement agreements.

Outgoing project correspondence and reports will be reviewed by the project manager or designee prior to mailing.

To prevent the inadvertent use of obsolete or superseded project-related procedures, all personnel of the laboratory and project staffs will be responsible for reporting changes in protocol to the Project Manager and the Laboratory Director. The Project Manager and Laboratory Director will then inform the project and laboratory staffs and the Quality Assurance Officer of these changes, as appropriate.

Revisions to procedures shall be subject to the same level of review and approval as the original document. Outdated procedures shall be marked "void". The voided document may be destroyed at the request of the Project Manager; however, it is recommended that one copy of the voided document be maintained in the project file. The date and reason why the document was voided will be recorded.

5.0 ANALYTICAL PROCEDURES

EPA-approved methods will be used for all analyses for which such methods exist. TCL parameters will be analyzed by CLP protocols. The laboratory will follow methods detailed in the CLP Statement of Work (SOW) for Organic Analyses and the SOW for Inorganic Analyses. If sample contaminant concentrations are high, then a departure from CLP protocols may be required in the sample analyses. In this case, sample runs at lower dilutions will be performed to obtain quantitative results for parameters present at lower concentrations. That is, samples are pre-screened to estimate concentration levels. According to EPA methodology, high concentration samples are diluted to bring them within a linear working range. Low concentration samples are set aside and then analyzed within the same linear working range. It may not be possible to quantitate sample results in parts per billion for samples where "pure" waste is encountered. In this event, a decision tree approach will be followed, in order to quantitate the sample when high levels of contamination are encountered. In this case, detection limits will be raised for all analytes on the sample, as the sample is diluted.

5.1 Target Compound List - Organic Compounds

All organic compounds analyses will be conducted according to the U.S. EPA CLP, Statement of Work, dated October 1987, or the latest version at the time of analysis. The organic compounds contained in the TCL will be determined using proven instruments and techniques to identify and quantify volatile, semi-volatile and pesticide/PCB compounds. The TCL compounds and CLP-required detection limits are shown in Tables 5 through 7 for these parameters. The actual detection limits obtainable for a specific sample depend upon matrix interferences. If the CLP detection limit is unachievable for a particular sample, an explanation of the problem and supporting evidence will be provided by the laboratory in the case narrative summary submitted with the deliverables.

A field duplicate sample will be analyzed for media sampled, as discussed in Section 2.0 of this document. Each set of samples will be analyzed in conjunction with the analysis of a set of QC samples including field duplicates, blanks, matrix spikes and matrix spike duplicate (MS/MSD) samples

TABLE 5

TARGET COMPOUND LIST (TCL) VOLATILE
COMPOUNDS AND DETECTION LIMITS

Volatiles	CAS Number	Detection Limits ^a	
		Low Water ^b (ug/L)	Low soil/Sediment ^c (ug/kg)
Chloromethane	74-87-3	10	10
Bromomethane	74-83-9	10	10
Vinyl chloride	75-01-4	10	10
Chloroethane	75-00-3	10	10
Methylene chloride	75-09-2	5	5
Acetone	67-64-1	10	10
Carbon disulfide	75-15-0	5	5
1,1-Dichloroethene	75-35-4	5	5
1,1-Dichloroethane	75-35-3	5	5
1,2-Dichloroethene (cis and trans)	156-60-5	5	5
Chloroform	67-66-3	5	5
1,2-Dichloroethane	107-06-2	5	5
2-Butanone	78-93-3	10	10
1,1,1-Trichloroethane	71-55-6	5	5
Carbon tetrachloride	56-23-5	5	5
Vinyl acetate	108-05-4	10	10
Bromodichloromethane	75-27-4	5	5
1,1,2,2-Tetrachloroethane	79-34-5	5	5
1,2-Dichloropropane	78-87-5	5	5
trans-1,3-Dichloropropene	10061-02-6	5	5
Trichloroethene	79-01-6	5	5
Dibromochloromethane	124-48-1	5	5
1,1,2-Trichloroethane	79-00-5	5	5
Benzene	71-43-2	5	5
cis-1,3-Dichloropropene	10061-01-5	5	5
2-Chloroethyl vinyl ether	110-75-8	10	10
Bromoform	75-25-2	5	5
2-Hexanone	591-78-6	10	10
4-Methyl-2-pentanone	108-10-1	10	10
Tetrachloroethene	127-18-4	5	5

(Continued)

TABLE 5
TARGET COMPOUND LIST (TCL) VOLATILE
COMPOUNDS AND DETECTION LIMITS

(Continued)

Volatiles	CAS Number	Detection Limits ^a	
		Low Water ^b (ug/L)	Low Soil/Sediment ^c (ug/kg)
Toluene	108-88-3	5	5
Chlorobenzene	108-90-7	5	5
Ethyl benzene	100-41-4	5	5
Styrene	100-42-5	5	5
Total xylenes		5	5

^a Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated for soil/sediment calculated on dry weight basis will be higher.

^b Medium water detection limits for volatile TCL compounds are 100 times the individual low water detection limits.

^c Medium soil/sediment detection limits for volatile TCL compounds are 100 times the individual low soil/sediment detection limits.

Note: Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

TABLE 6

TARGET COMPOUND LIST (TCL) SEMI-VOLATILE
COMPOUNDS AND DETECTION LIMITS

Semi-Volatiles	CAS Number	Detection Limits ^a	
		Low Water ^b (ug/L)	Low Soil/Sediment ^c (ug/kg)
Phenol	108-95-2	10	330
Bis(2-chloroethyl) ether	111-44-4	10	330
2-Chlorophenol	95-57-8	10	330
1,3-Dichlorobenzene	541-73-1	10	330
1,4-Dichlorobenzene	106-46-7	10	330
Benzyl alcohol	100-51-6	10	330
1,2-Dichlorobenzene	95-50-1	10	330
2-Methylphenol	95-48-7	10	330
Bis(2-chloroisopropyl) ether	39638-32-9	10	330
4-Methylphenol	106-44-5	10	330
N-Nitroso-dipropylamine	621-64-7	10	330
Hexachloroethane	67-72-1	10	330
Nitrobenzene	98-95-3	10	330
Isophorone	78-59-1	10	330
2-Nitrophenol	88-75-5	10	330
2,4-Dimethylphenol	105-67-9	10	330
Benzoic acid	65-85-0	50	1600
Bis(2-chloroethoxy) methane	111-91-1	10	330
2,4-Dichlorophenol	120-83-2	10	330
1,2,4-Trichlorobenzene	120-82-1	10	330
Naphthalene	91-20-3	10	330
4-Chloroaniline	106-47-8	10	330
Hexachlorobutadiene	87-68-3	10	330
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
2-Methylnaphthalene	91-57-6	10	330
Hexachlorocyclopentadiene	77-47-4	10	330
2,4,6-Trichlorophenol	88-06-2	10	330
2,4,5-Trichlorophenol	95-95-4	50	1600

(Continued)

TABLE 6
TARGET COMPOUND LIST (TCL) SEMI-VOLATILE
COMPOUNDS AND DETECTION LIMITS

(Continued)

Semi-Volatiles	CAS Number	Detection Limits ^a	
		Low Water ^b (ug/L)	Low Soil/Sediment ^c (ug/kg)
2-Chloronaphthalene	91-58-7	10	330
2-Nitroaniline	88-74-4	50	1600
Dimethyl phthalate	131-11-3	10	330
Acenaphthylene	208-96-8	10	330
3-Nitroaniline	99-09-2	50	1600
Acenaphthene	83-32-9	10	330
2,4-Dinitrophenol	51-28-5	50	1600
4-Nitrophenol	100-02-7	50	1600
Dibenzofuran	132-64-9	10	330
2,4-Dinitrotoluene	121-14-2	10	330
2,6-Dinitrotoluene	606-20-2	10	330
Diethylphthalate	84-66-2	10	330
4-Chlorophenyl phenyl ether	7005-72-3	10	330
Fluorene	86-73-7	10	330
4-Nitroaniline	100-01-6	50	1600
4,6-Dinitro-2-methylphenol	534-52-1	50	1600
N-nitrosodiphenylamine	86-30-6	10	330
4-Bromophenyl phenyl ether	101-55-3	10	330
Hexachlorobenzene	118-74-1	10	330
Pentachlorophenol	87-86-5	50	1600
Phenanthrene	85-01-8	10	330
Anthracene	120-12-7	10	330
Di-n-butylphthalate	84-74-2	10	330
Fluoranthene	206-44-0	10	330
Pyrene	129-00-0	10	330
Butyl benzyl phthalate	85-68-7	10	330
3,3'-Dichlorobenzidine	91-94-1	20	660
Benzo(a)anthracene	56-55-3	10	330
Bis(2-ethylhexyl)phthalate	117-81-7	10	330
Chrysene	218-01-9	10	330

(Continued)

TABLE 6
 TARGET COMPOUND LIST (TCL) SEMI-VOLATILE
 COMPOUNDS AND DETECTION LIMITS

(Continued)

Semi-Volatiles	CAS Number	Detection Limits ^a	
		Low Water ^b (ug/L)	Low Soil/Sediment ^c (ug/kg)
Di-n-octyl phthalate	117-84-0	10	330
Benzo(b)fluoranthene	205-99-2	10	330
Benzo(k)fluoranthene	207-08-9	10	330
Benzo(a)pyrene	50-32-8	10	330
Indeno(1,2,3-cd)pyrene	193-39-5	10	330
Dibenzo(a,h)anthracene	53-70-3	10	330
Benzo(g,h,i)perylene	191-24-2	10	330

^a Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated for soil/sediment calculated on dry weight basis will be higher.

^b Medium water detection limits for volatile TCL compounds are 100 times the individual low water detection limits.

^c Medium soil/sediment detection limits for volatile TCL compounds are 60 times the individual low soil/sediment detection limits.

Note: Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

TABLE 7
TARGET COMPOUND LIST (TCL) PESTICIDES, PCBs,
AND DETECTION LIMITS

Pesticides/PCBs	CAS Number	Detection Limits ^a	
		Low Water ^b (ug/L)	Low Soil/Sediment ^c (ug/kg)
alpha-BHC	319-84-6	0.05	8.0
beta-BHC	319-85-7	0.05	8.0
delta-BHC	319-86-8	0.05	8.0
gamma-BHC (Lindane)	58-89-9	0.05	8.0
Heptachlor	76-44-8	0.05	8.0
Aldrin	309-00-2	0.05	8.0
Heptachlor epoxide	1024-57-3	0.05	8.0
Endosulfan I	959-98-8	0.05	8.0
Dieldrin	60-57-1	0.10	16.0
4,4'-DDE	72-55-9	0.10	16.0
Endrin	72-20-8	0.10	16.0
Endosulfan II	33213-65-9	0.10	16.0
4,4'-DDD	72-54-8	0.10	16.0
Endrin adehyde	7421-93-4	0.10	16.0
Endosulfan sulfate	1031-07-8	0.10	16.0
4,4'-DDT	50-29-3	0.10	16.0
Endrin ketone	53494-70-5	0.10	16.0
Methoxychlor	72-43-5	0.5	80.0
Chlordane	57-74-9	0.5	80.0
Toxaphene	8001-35-2	1.0	160.0
AROCLOR-1016	12674-11-2	0.5	80.0
AROCLOR-1221	11104-28-2	0.5	80.0
AROCLOR-1232	11141-16-5	0.5	80.0
AROCLOR-1242	53469-21-9	0.5	80.0
AROCLOR-1248	12672-29-6	0.5	80.0
AROCLOR-1254	11097-69-1	1.0	160.0
AROCLOR-1260	11096-82-5	1.0	160.0

^a Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated for soil/sediment calculated on dry weight basis will be higher.

^b Medium water detection limits for volatile TCL compounds are 100 times the individual low water detection limits.

^c Medium soil/sediment detection limits for volatile TCL compounds are 15 times the individual low soil/sediment detection limits.

Note: Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

for quality control determinations. The frequency of analyses of the QC samples will not be less than one set per 20 samples, and at least one per sampling day for field blanks and not less than one set per 10 samples for field duplicate and MS/MSD or one per sampling day. All samples, field duplicates, blanks, matrix spiked and matrix spike duplicates will be fortified with surrogate spiking compounds as shown in Table 8. The CLP recommended guidelines for percentage recovery of the surrogate compounds are provided in Table 9. The percentage recovery of the matrix spiking compounds and relative percentage difference of duplicate analyses will be calculated to obtain measurements of the analyses accuracy and precision.

5.2 Target Compound List - Metals

All water and soil samples will be prepared for analyses as described by procedures for each respective matrix and analysis method described in the U.S. EPA CLP, Statement of Work, dated July 1987, or latest version applicable at the time of analyses. Each set of samples, or 20 samples, whichever is more frequent, will be analyzed with a preparation blank, duplicate sample, and matrix spiked sample. Each group of 20 samples will be analyzed with a laboratory control sample of similar matrix. The TCL for metals and inorganics is listed on Table 10.

The atomic absorption (AA) instrument will be calibrated through the use of a minimum of three calibration standards prepared by dilution of certified stock solutions. Calibration standards will contain acid(s) at the same concentration as the digestates. An analysis blank will then be prepared, and one calibration standard will be at the EPA-CLP required detection limit for the metal being evaluated. The other standard concentrations will bracket the concentration range of the samples. A continuing calibration standard, prepared from a different stock solution than that used for the calibration standards, will be prepared and analyzed after every ten samples or every two hours of continuous instrument operation. The value of the continuing calibration standard concentration must agree with requirements under the current CLP SOW.

5.3 Petroleum Hydrocarbons

EPA Method 418.1 will be used for analysis of petroleum hydrocarbons. "Petroleum hydrocarbons" is a measure of the non-biodegradable mineral oils in

TABLE 8
SURROGATE SPIKE RECOVERY RANGE

Fraction	Surrogate Compounds	Water % Recovery	Soil/Sediment % Recovery
<u>Volatiles</u>	Toluene-d ₈	86-119	50-160
	4-Bromofluorobenzene	85-121	50-160
	1,2-Dichloroethane-d ₄	77-120	50-160
<u>Semi-Volatiles</u>	Nitrobenzene-d ₅	41-120	20-140
	2-Fluorobiphenyl	44-119	20-140
	p-Terphenyl-d ₁₄	33-128	20-150
	Phenol-d ₅	15-103	20-140
	2-Fluorophenol	23-121	20-140
	2,4,6-Tribromophenol	10-131	10-141
<u>Pesticides</u>	Dibutylchloredate	48-136	20-150

TABLE 9
MATRIX SPIKE RECOVERY LIMITS^a

Fraction	Matrix Spike Compound	Water ^a	Soil/Sediment ^a
VOA	1,1-Dichloroethene	61-145	59-172
VOA	Trichloroethene	71-120	62-137
VOA	Chlorobenzene	75-130	60-133
VOA	Toluene	76-125	59-139
VOA	Benzene	76-127	66-142
BN	1,2,4-Trichlorobenzene	39-98	38-107
BN	Acenaphthene	46-118	31-137
BN	2,4-Dinitrotoluene	24-96	28-89
BN	Pyrene	26-127	35-142
BN	N-Nitroso-di-n-propylamine	41-116	41-126
BN	1,4-Dichlorobenzene	36-97	28-104
Acid	Pentachlorophenol	9-103	17-109
Acid	Phenol	12-89	26-90
Acid	2-Chlorophenol	27-123	25-102
Acid	4-Chloro-3-methylphenol	23-97	26-103
Acid	4-Nitrophenol	10-80	11-114
Pesticide	Lindane	56-123	46-127
Pesticide	Heptachlor	40-131	35-130
Pesticide	Aldrin	40-120	34-132
Pesticide	Dieldrin	52-126	31-134
Pesticide	Endrin	56-121	42-139
Pesticide	4,4'-DDT	38-127	23-134
Metals: CN		75-125	75-125

^a These limits are for advisory purposes only. They are not to be used to determine if a sample should be reanalyzed. When sufficient multi-laboratory data are available, standard limits will be calculated.

TABLE 10

TARGET COMPOUND LIST (TCL) INORGANICS AND
CONTRACT REQUIRED DETECTION LIMITS (CRDL)^a

Element	Detection Limit	
	Water (ug/L)	Low Soil/Sediment (ug/g)
Aluminum	200	20
Antimony	60	6
Arsenic	10	1
Barium	200	20
Beryllium	5	0.5
Boron	5	0.5
Cadmium	5	0.5
Calcium	5,000	500
Chromium	10	1
Cobalt	50	5
Copper	25	2.5
Iron	100	10
Lead	5	0.5
Magnesium	5,000	500
Manganese	15	1.5
Mercury	0.2	0.1 ^b
Nickel	40	4
Potassium	5,000	500
Selenium	5	0.5
Silver	10	1
Sodium	5,000	500
Thallium	10	1
Vanadium	50	5
Zinc	20	2
Cyanide	10	1

^a Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

^b Different aliquot.

the sample. The detection limit for a water sample is 2 milligrams per liter (mg/L) and that for soil/sediment is 20 micrograms per gram (ug/g).

The method is applicable to measurement of light fuels, although loss of approximately half of any gasoline present during extraction manipulations can be expected. In the procedure, the sample is acidified to a low pH (<2) and serially extracted with fluorocarbon-113 in a separatory funnel. Interferences are removed with silica gel adsorbent. Infrared analysis of the extract is performed by direct comparison with standards.

5.4 Toxicity Characteristic Leaching Procedure (TCLP) Analysis

Full TCL compounds will be analyzed for in the TCLP extract using methods described in this QA/QC Plan, and procedures outlined in the proposed TCLP Method 1311 presented in the November 7, 1986 Federal Register.

5.5 EP Toxicity Analysis

Sludge samples will be collected for those metal, pesticide, and herbicide compounds listed under the EP Toxicity procedure described in Test Methods for Evaluating Solid Waste, SW-846, Third Edition, November 1986, and presented in 40 CFR Part 261.24.

5.6 Dioxin Analysis (2,3,7,8-TCDD)

Soil and waste samples will be collected and archived for 2,3,7,8-TCDD analysis according to CLP-SOW protocols. The samples will be collected in a 250-ml wide-mouth amber jar and stored at 4°C until shipment to the laboratory can be arranged.

6.0 QUALITY ASSURANCE OBJECTIVES FOR THE MEASUREMENT DATA

The overall quality assurance objective for laboratory analysis of soil, waste, sediment, ground water, and surface water samples is to provide a laboratory QA/QC program that is, at a minimum, equal to the U.S. EPA Contract Laboratory Program (CLP). The quality control limits of accuracy and precision for laboratory analyses are governed by the methods and equipment used by the laboratory. Laboratory QA/QC requirements defined in CLP protocol are designed to ensure that acceptable levels of data accuracy and precision are maintained throughout the analytical program. These QA/QC requirements are detailed in the CLP Statement of Work (SOW) for Target Compound List (TCL) analytes, and will be followed by the laboratory during this study.

It must be recognized that QA objectives may be attainable only for samples that are homogeneous or have inherent matrix-related problems. In the event that QA objectives cannot be met on specific samples, groups of samples or sample types, the laboratory will make every reasonable effort to determine the cause of non-attainment and, if such is due to instrument malfunction, operator error, or other identifiable cause within the laboratory's control, the samples affected will be reanalyzed, if possible. Should non-attainment of QA objectives be due to sample in-homogeneity, sample matrix interference, or other sample-related causes, reanalyses will be treated as additional analyses.

For many EPA-approved methods, inter-laboratory method verification studies have been used to establish QC criteria which may be regarded as an inherent part of the method. In those cases, such criteria will take precedence, except for deviations from such criteria that can be reasonably attributed to sample-related cases.

The quality assurance objectives for all measurement data include considerations of precision, accuracy, completeness, representativeness, and comparability as described below.

6.1 Precision and Accuracy

The precision of a measurement is an expression of mutual agreement of multiple measurement values of the same property conducted under prescribed

similar conditions. Precision reflects the repeatability of the measurement. Precision is evaluated most directly by recording and comparing multiple measurements of the same parameter on the same sample under the same conditions. Precision is usually expressed in terms of standard deviation. The precision objectives for TCL parameters are specified in the CLP protocols. Except as otherwise specified by the method, the QC objective for precision under this project will be ± 20 percent (relative percent difference) as determined by duplicate analyses. It must be recognized that for analytes at concentrations of less than five to ten times the method detection limit (MDL), this objective is unlikely to be met.

The degree of accuracy of a measurement is based on a comparison of the measured value with an accepted reference or true value, or is a measure of system bias. Accuracy of an analytical procedure is best determined based on analysis of a known or "spiked" sample quantity. The degree of accuracy and the recovery of analyte to be expected for the analysis of QA samples and spiked samples is dependent upon the matrix, method of analysis, and compound or element being determined in the analysis. The concentration of the analyte relative to the detection limit is also a major factor in determining the accuracy of the measurement. Except as otherwise specified by a method, the QC objective for accuracy under this project will be 75 to 125 percent (percent recovery), as determined by sample spike recoveries. Alternatively, accuracy may be assessed through the analysis of appropriate standard reference materials, certified standards, or samples, as available.

6.2 Completeness

Completeness is a measure of the amount of valid data obtained from the measurement system relative to the amount anticipated under ideal conditions. This project's QC objective for completeness, as determined by the percentage of valid data generated, will be ≥ 90 percent.

6.3 Representativeness

Samples taken must be representative of the sampled population. Where appropriate, the population will be statistically characterized to express: 1) the degree to which the data accurately and precisely represent a characteristic of a population, 2) parameter variations at a sampling point,

and 3) a process, or an environmental condition. Sample selection and handling procedures will incorporate consideration of obtaining the most representative sample possible. Sampling devices will be decontaminated between sampling points to ensure that cross-contamination does not occur between samples.

Three types of sample blanks will be utilized during this program: trip blanks and field blanks, and source blanks. Trip blanks will consist of a sample vial filled with laboratory-supplied, analyte-free, deionized water that will remain closed and accompany the sample container shipment to and from the laboratory. The trip blanks will be analyzed in order to evaluate the effect of ambient site conditions and sample shipment on sample integrity, and to ensure proper sample container preparation and handling techniques. A trip blank will accompany all volatile organic analysis (VOA) samples (water, soil, and sediment and waste) shipped to the laboratory.

Field blanks will be collected by pouring laboratory-supplied, analyte-free deionized water directly over the decontaminated sample collection equipment (e.g., bailers, spoons) and into the appropriate sample containers. A minimum of one field blank for every twenty samples or per sample matrix per day will be collected during the investigation. The analytical results of the field blanks will be used to ensure that the sampling equipment decontamination procedures have been adequate.

A source blank will be collected from the source water used for equipment decontamination and monitoring well construction. The source blank samples will be analyzed for the same parameters as the related samples. The results of the analyses of these samples will indicate the type and level of chemical compounds in the source water.

Representativeness of specific samples will be achieved by the following:

- Collect samples from the location fully representing the site conditions;
- Use appropriate sampling procedures and equipment;
- Use appropriate analytical methodologies; and

- Analyze for appropriate parameters using appropriate detection limits.

For this program, one field duplicate will be prepared for every 10 samples collected. In addition, one matrix spike and one matrix spike duplicate sample will be collected and subsequently analyzed by the laboratory for every 10 samples of a given matrix type, in accordance with the CLP SOW. Also, one method blank and one method spike will be analyzed per ten samples in accordance with the CLP SOW.

Field duplicate and field blank samples will be shipped to the laboratory as "blind" samples. These samples will be numbered similarly to other samples except that fictitious sample station numbers will be assigned to the samples. Trip blanks will be labeled as such and shipped with samples being analyzed for volatile analyses. Samples for matrix spike and matrix spike duplicates will be designated on the chain-of-custody forms and sample labels. Samples for matrix spike and matrix spike duplicate analyses for TCL VOA and BNA analyses will be collected in triplicate.

The laboratory will make appropriate efforts to ensure that samples are adequately homogenized prior to taking aliquots for analysis, so that reported results are representative. Some techniques of homogenization (i.e., compositing of VOA samples with subsequent loss of volatiles during compositing) expose the sample to significant risk of contamination or loss through volatilization, and will be avoided.

6.4 Comparability

Consistency in sample acquisition, handling, analysis and QA/QC level is necessary so that analytical results may be compared. Where appropriate, analytical results will be compared with the results obtained in previous studies. Therefore, the laboratory will use EPA approved methods and reporting units, in order to assure that the data will be comparable to other similarly generated data sets.

7.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

7.1 Introduction

Procedures used to assess data precision and accuracy will be in accordance with 44 CFR 69533 "Guidelines Establishing Test Procedures for the Analyses of Pollutants", Appendix III Example Quality Assurance and Quality Control Procedures for Organic Priority Pollutants", December 3, 1979. Completeness is recorded by comparing the number of parameters initially analyzed with the number of parameters successfully completed and validated. A target control limit of greater than 90 percent will be used for this project.

7.2 Accuracy

The percent recovery is calculated as:

$$\% = \frac{S_s - S_o}{S} \times 100$$

where: S_o = The background value, i.e., the value obtained by analyzing the sample.

S = Concentration of the spike added to the sample.

S_s = Value obtained by analyzing the sample with the spike added.

$\%$ = Percent recovery.

7.3 Precision

The relative percent difference is calculated as:

$$\% \text{ difference} = 1/2 \times \frac{V_1 - V_2}{(V_1 + V_2)} \times 100$$

where: V_1, V_2 = The two values obtained by analyzing the duplicate samples.

7.4 Completeness

Completeness will be reported as the percentage of all measurements made whose results are judged to be valid. The procedures to be used for

validating data and determination of outliers are contained in Section 8.0 of this QA/QC Plan. The following formula will be used to estimate completeness:

$$C = 100 \frac{V}{T}$$

where: C = Percent completeness.

V = Number of measurements judged valid.

T = Total number of measurements.

8.0 DATA REDUCTION, VALIDATION, AND REPORTING

8.1 Introduction

The procedures used for calculations and data reduction are specified in each analytical method referenced in Section 5.0 of this document. Raw data will be entered in bound laboratory notebooks. A separate book will be maintained for each analytical procedure. The data will be entered such that sufficient space remains to enter all subsequent calculations required to arrive at the final (reported) value for each sample. Calculations include factors such as sample dilution ratios, corrections for blank readings and titrant normality, and conversion to dry-weight basis for solid samples. Instrument chart recordings and calculator printouts will be labeled and attached to their respective pages, except for voluminous gas chromatograms which will be cross-referenced and stored separately.

Calculations will be checked from the raw data to final value stages prior to reporting the results of a group of samples. Results obtained from extreme ends of standard curves generated by linear regression calculator programs will be checked against graphically-produced standard curves if the correlation coefficient of a program curve is less than 0.995.

Data will generally be reported as milligrams of analyte per liter for aqueous samples or milligrams per kilogram for solid or non-aqueous liquid samples. Concentration units will always be listed on reports and any special conditions, such as dry weight conversions, will be noted. The data reporting form will also include the unique sample number assigned to each sample, details of sample collection including the client's identification number, and the dates of sample receipt and report preparation.

8.2 Data Reduction

8.2.1 Target Compound List Compounds

Instrument performance test data will accompany the raw data during data reduction. The following criteria must be attained to make a qualitative identification of an organic pollutant using Gas Chromatograph/Mass Spectrometer (GC/MS) techniques:

- Characteristic ions for each compound of interest must maximize in the same or within one scan of each other.

- Retention time must occur within +1 percent of the retention time of the authentic compound.
- Relative peak heights of the three characteristic ions in the Extracted Ion Current Profile (EICP) must fall within +20 percent of the relative intensities of these ions in a reference mass spectrum. The reference mass spectrum can be obtained by a standard analyzed in the GC/MS system or from a reference library.
- The entire mass spectrum of the compound of interest is compared to the reference compound.

Structural isomers having similar mass spectra can be explicitly identified only if the resolution between authentic isomers in a standard mix is acceptable. Acceptable resolution is achieved if the baseline-to-valley height between the isomers is less than 25 percent of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

When a compound has been identified, the quantitation of that compound is based on the integrated abundance from the EICP of the primary characteristic ion. The base peak ion of internal and surrogate standards is used in the quantitation. If the sample produces an interference for the first listed ion, a secondary ion is used to quantitate. Quantification is performed using internal standard techniques.

When the internal standard calibration procedure is used, the concentration in the sample is calculated by using the response factor (RF), as determined by the following equation:

$$\text{Concentration (g/L)} = \frac{(A_s)(I_s)}{(A_{is})(Rf)(V_o)}$$

where: g/L = Units in grams per liter

A_s = Area of the characteristic ion for the parameter to be measured.

A_{is} = Area of the characteristic ion for the internal standard.

I_s = Amount of internal standard added to each extract (g).

V_o = Volume of water extracted (liters).

Rf = Response factor.

To ensure that reported data are accurate, all such resultant data are verified. Retention items and area counts are checked carefully for correct identification and accurate quantification.

8.2.2 Metals and Cyanide

The concentrations of metals determined by Atomic Absorption Spectroscopy (AAS) measurements are obtained by comparison of absorbance values with those obtained from the analyses of known standards. A linear regression plot of absorbance versus concentration will be used to determine a concentration factor for linearity of response.

In the event of low spike recovery, the analysis will be repeated using the method of known additions to determine potential matrix interferences. CLP criteria will be maintained for analyses of samples of similar matrix. The mean percentage recovery and standard deviation will be calculated from a minimum of 20 analyses. A warning limit of ± 2 standard deviations from the mean and a control limit of ± 3 standard deviations will be used to establish that the test is providing accurate data.

8.3 Data Validation

Data validation is the process of filtering data and accepting or rejecting it on the basis of sound criteria. Project supervisory and QC personnel will use validation methods and criteria appropriate to the type of data and the purpose of the measurement. Records of all data will be maintained, even that judged to be an "outlying" or anomalous value. The QA/QC Manager validating the data will have sufficient knowledge of the technical work to identify questionable values.

8.3.1 Field Data Validation

Field sampling data will be validated by the TRC Field QC Coordinator-QA/QC Manager, based on their judgment of the representativeness of the sample, maintenance and cleanliness of sampling equipment, and adherence to the approved, written sample collection procedure.

The following criteria will be used to evaluate the field sampling data:

- Use of approved sampling procedures;

- Use of reagents that have conformed to QC specified criteria; and
- Proper chain-of-custody maintained and documented.

8.3.2 Analytical Data Validation

Analytical data will be evaluated by EPA CLP protocols, modified by Navy/NEESA guidance for Level C, as shown in Appendix A to this QA/QC Plan.

Data from laboratory analyses will be validated by the laboratory QC Coordinator using criteria outlined in the QA/QC Plan. Results from field and laboratory method blanks, replicate samples, equipment rinsates and internal QC samples will be used to validate analytical results.

The criteria listed below will be used to evaluate the analytical data:

- Use of approved analytical procedures;
- Use of properly operating and calibrated instrumentation;
- Acceptable results from analyses of laboratory control samples (i.e., the reported values should fall within the 95 percent confidence interval for these samples); and
- Precision and accuracy for this project should be comparable so that achieved in previous analytical programs are consistent with objectives stated in Section 5 of this QA/QC Plan.

Consistent with EPA Region I's current procedures, analytical data validations will follow EPA/CLP guidance. Recent NEESA guidance will also be followed in the validation. The following documents will be of assistance:

- Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program (NEESA 20.2-047B), July 1988;
- U.S. EPA, Laboratory Data Validation Functional Guidelines for Evaluating Organic Analysis, Technical Directive Document No. HQ-8410-01, April 1985; and
- U.S. EPA, Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analysis Office of Emergency and Remedial Response, April 1985.

For inorganic analyses, the following guidance from the above references is used to compare field and trip blank results with sample data:

(USEPA Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analysis, pg. 23):

If a contaminant analyte is detected in samples at a concentration of less than five times the concentration found in the highest associated blank (preparation, field, or trip), these results should be considered suspect. The results should be flagged with a "J". This result should be discussed in the QC section of the final report.

For organics, the following guidance applies:

(USEPA Laboratory Data Validation Functional Guidelines for Evaluating Organic Analysis, pg. 23):

No positive results are reported unless the concentration of the compound in the sample exceeds ten times the amount in any blank for the common contaminants or five times the amount for other compounds. The results should not be corrected by subtracting the blank value. Specific actions are as follows:

- If common contaminant compounds are detected in samples at a concentration of less than ten times the concentration found in the blank, or other compounds at less than five times the concentration in the blank, report those compounds as not detected. Adjust the sample quantitation limit to the value reported in the sample and flag the limit as estimated (J).
- If gross contamination exists (i.e., saturated peaks by GC/MS), all compounds affected should be reported as unusable (R) due to interference in all samples affected.

8.4 Identification and Treatment of Outliers

Any data point which deviates markedly from others in its set of measurements will be investigated; however, the suspected outlier will be recorded and retained in the data set. One or both of the following tests will be used to identify outliers.

Dixon's test for extreme observations is an easily computed procedure for determining whether a single very large or very small value is consistent with the remaining data. The one-tailed t-test for difference may also be used in this case. It should be noted that these tests are designed for testing a single value. If more than one outlier is suspected in the same data set, other statistical sources will be consulted and the most appropriate test of hypothesis will be used and documented.

Since an outlier may result from unique circumstances at the time of sample analysis or data collection, those persons involved in the analysis and data reduction will be consulted. This may provide information on an experimental reason for the outlier. Further statistical analysis will be performed with and without the outlier to determine its effect on the conclusions. In many cases, two data sets will be reported, one including and one excluding the outlier.

In summary, every effort will be made to include the outlying values in the reported data. If the value is rejected, it will be identified as an outlier, reported with its data set and its omission noted.

8.5 Analytical Deliverables

NEESA Level C reporting requirements shown in Appendix A of this document will be applied to the data reports. These requirements call for modified CLP data reporting packages.

9.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

9.1 Introduction

Quality control checks will be performed to ensure the collection of representative samples and the generation of valid analytical results on these samples. These checks will be performed by project participants through the program under the guidance of the TRC QA Officer.

9.2 Data Collection and Sampling QC Procedures

The TRC internal QC checks for the sampling aspects of this program will include, but not be limited to, the following:

- Use of field notebooks to ensure completeness, traceability, and comparability of the samples collected.
- Field checking of field notebooks and sample labels by a second person to ensure accuracy and completeness.
- Strict adherence to the sample chain-of-custody procedures outlined in Section 4 of this document.
- Collection and analysis of trip blanks, source blanks, field blanks, and field duplicates.
- Calibration of the field monitoring equipment (HNU and/or OVA) will be performed daily.

9.3 Analytical QC Procedures

9.3.1 Trip Blank Analysis

Volatile organic samples are susceptible to contamination by diffusion of organic contaminants through the Teflon-faced silicone rubber septum of the sample vial. Therefore, trip blanks will be analyzed to monitor for possible sample contamination during shipment. Trip blanks will be prepared by filling two volatile vials with laboratory-supplied organic-free water which will be shipped with the field kit. Trip blanks accompany the sample bottles through collection and shipment to the laboratory and are stored with the samples. Following the analyses, if the trip blanks indicate possible contamination of the samples, depending upon the nature and extent of the contamination, the samples will be qualified with respect to the contamination detected in the trip blanks. Results of trip blank analyses will be maintained with the corresponding sample analyses data in the project file.

9.3.2 Reagent Blank Analysis

A reagent blank is a volume of deionized, distilled laboratory water carried through the entire analytical procedure. The volume of the blank must be approximately equal to the sample volume processed. A reagent blank should be performed with each group of samples. Analysis of the blank verifies that method interferences caused by contaminants in solvents, reagents, glassware, and other sample processing hardware are known and minimized. Optimally, a reagent blank should meet CLP criteria. Results of reagent blank analyses will be maintained with the corresponding analytical data in the project file.

9.3.3 Duplicate Sample Analysis

Duplicate analyses are performed to evaluate the precision of an analysis. Results of the duplicate analyses are used to determine the relative percent differences between duplicate samples. Field (blind) duplicate samples will be collected for each media sampled. Duplicate analysis results will be summarized on the quality control data summary form.

9.3.4 Verification/Reference Standard

On a quarterly basis, the laboratory Quality Control Coordinator introduces a group of prepared verification samples, or standard reference materials, into the analytical testing regime. Results of these data will be summarized, evaluated, and presented to laboratory management for review and corrective actions, if appropriate.

9.3.5 Other Laboratory Quality Control Checks

Quality control checks will be performed to ensure the collection of representative samples and the generation of valid analytical results on these samples. These checks are performed by project participants under the guidance of QC personnel.

The laboratory will make use of various types of QC samples to document the validity of the generated data. The following types of QC samples are routinely used:

- Calibration Check Samples--One of the working calibration standards which is periodically used to check that the original calibration is still valid.

- Spiked Samples--Replicate aliquots of project samples are spiked with components of interest and carried through the entire preparative and analytical scheme.
- Laboratory Control Samples (LCS)--These samples are prepared from EPA Environmental Monitoring Systems Laboratory (EMSL) concentrates or National Bureau of Standards (NBS) standard reference materials. The LCS are used to establish that an instrument or procedure is in control. An LCS is normally carried through the entire sample preparation and analysis procedure.
- Surrogate Spikes--Samples requiring analysis by GC/MS are routinely surrogate-spiked with a series of deuterated analogues of the components of interest. It is anticipated that these compounds would assess the behavior of actual components in individual program samples during the entire preparation and analysis scheme.
- Matrix Spikes/Matrix Spike Duplicates (MS/MSD)--One MS/MSD pair will be run per 20 samples for each different matrix analyzed. These pairs will be spiked with the target compounds of concern for that matrix.

All values which fall outside the QC limits described in the analytical method will be noted. The following analytical guidelines will be used to check recovery values which fall outside the QC limits:

1. All recovery data are evaluated to determine if the QC limits are appropriate and if a problem may exist even though the limits are being achieved (e.g., one compound that is consistently barely within the lower limit).
2. All recovery data which are outside the established limits are evaluated. This evaluation includes an independent check of the calculation.
3. Corrective action is performed if any of the following are observed:
 - All recovery values in any one analysis are outside the established limits.
 - Over 50 percent of the values for a given sample set are outside limits.
 - One compound is outside the limits in over 50 percent of the samples.

Reagents used in the laboratory are normally of analytical reagent grade or higher purity. Each lot of acid or solvent used is checked for

acceptability prior to laboratory use. All reagents are labeled with the date received and date opened. All glassware is precleaned according to specifications contained in the analytical method. Standard laboratory practices for laboratory cleanliness, personnel training, and other general procedures are used. A summary of all laboratory quality control analyses and the corresponding control determination is presented in Table 11.

9.3.6 Laboratory Control Charts

The control chart displays data in a format which graphically compares the variability of all test results with the average or expected variability of small groups of data. The variability may be due to random (indeterminate) or assignable (determinate) causes. The control chart distinguishes indeterminate from determinate variation in a process or method by its control limits. If a value falls outside the control limits, it is considered out-of-control, almost certainly due to a determinate cause which has been added to the indeterminate variations. The control chart signals the need to investigate, find the determinate cause, and correct it. Construction of a control chart requires a minimum of 14 to 20 duplicate sets of data points (which limits its use).

QC samples and instrument calibrations lend themselves most readily to the gathering of the data. Calculation of control limits and the values are usually plotted chronologically so that trends or cycles can be readily detected. If QC sample measurements show an out-of-control condition, it can be expected that subsequent sample analyses might yield invalid data. The control chart is an effective indicator of the need for corrective action.

For volatile and semi-volatile organics and pesticide analyses performed by GC/MS, surrogate recoveries from the method blank are the control sample. For other organics (e.g., PCBs, 2,3,7,8-TCDD), an LCS (spiked blank) is used to plot the control charts. An LCS is also used as the control point for inorganic analyses.

TABLE 11
LABORATORY QUALITY CONTROL ANALYSES

Analysis type	Frequency ^a	Control
<u>Organic analyses</u>		
Blank	1	Surrogate compounds
LCS and/or spiked blank	1	% recovery, analytes of interest
Duplicate	1	RPD
Matrix spike	1	% recovery of target analyte(s)
Matrix spike duplicate	1	RPD and % recovery
<u>Inorganic Analyses</u>		
Blank	1	No contamination
LCS and/or spiked blank	1	% recovery, analytes of interest
Duplicate	1	RPD
Matrix spike	1	% recovery of target analyte(s)

^a Frequency is based on a batch of 20 samples or less of a similar matrix or whenever samples are extracted, whichever is more frequent.

LCS = Laboratory Control Sample

RPD = Relative Percent Difference

10.0 CALIBRATION PROCEDURES AND FREQUENCY

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the instrument manufacturer's specifications.

Calibration procedures and frequency associated with laboratory instrumentation are specified in the Contract Laboratory Program (CLP) Statement of Work (SOW), and will be strictly followed for those analytes analyzed by CLP protocols. For all other analyses for which EPA approved methods exist, the laboratory will employ such methods and follow the specified calibration procedures and frequencies. The laboratory quality control program includes strict adherence to routine calibration procedures. A description of calibration procedures and frequencies for non-CLP methods will be provided by the laboratory selected for this program.

Calibration of field instruments will be performed at approved intervals as specified by the manufacturer or more frequently, as conditions dictate. Calibrations may also be performed at the start and completion of each test run; however, such calibrations will be re-initiated as a result of delay due to meals, work shift change, or instrument damage. Calibration standards used as reference standards will be traceable to the National Bureau of Standards (NBS), when possible. Calibration procedures for field instruments are included in Appendix B of this plan.

Analysis of blank samples, duplicate samples, spiked blanks, and matrix blanks will be performed where possible to document the effectiveness of calibration procedures. The number, frequency, and type of these samples will be sufficient to verify the success of the calibration program (at least 20 percent of all samples).

Method blanks contain all the reagents used in the preparation and analysis of the samples and are processed through the entire analytical scheme to assess spurious contamination from reagents, glassware and other materials used during analysis. The terms method blank and laboratory blank are

interchangeable. A matrix blank denotes a blank of a similar matrix (e.g., for liquids a blank of distilled-deionized reagent grade high purity water may be used; for soils/sediments high purity sand may be used). A spike blank is a method blank which has had a known concentration of a particular compound or analyte added to it to assure adequate percent recovery of the compound/analyte.

Records of calibration, repair, or replacement will be maintained by the designated laboratory personnel performing quality control activities. Calibration records of assigned laboratories will be filed and maintained at the laboratory location where the work is performed and subject to QA audit.

11.0 PREVENTIVE MAINTENANCE

11.1 Preventive Maintenance Procedures

Field equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedure developed by the operators.

The laboratory will follow an orderly program of positive actions to prevent the failure of laboratory equipment or instruments during use. This preventive maintenance and careful calibration helps to assure accurate measurements from instrumentation. Routine maintenance procedures are followed for all instruments, glassware, reagents, analytical balances, and equipment used to produce deionized water. Specific procedures will be outlined in the laboratory Standard Operating Procedures (SOPs).

11.2 Schedules

Manufacturer's procedures identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the operator to adhere to this maintenance schedule and to arrange any necessary and prompt service as required. Service to the equipment, instruments, tools, gauges, etc., shall be performed by qualified personnel.

In the absence of any manufacturer's recommended maintenance criteria, a maintenance procedure will be developed by the operator based upon experience and previous use of the equipment.

11.3 Records

Logs are maintained to record maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools and gauges. Records produced shall be reviewed, maintained, and filed by the operators at the laboratories and by the data and sample control personnel when and if equipment, instruments, tools and gauges are used at the sites. The project QA officer may audit these records to verify complete adherence to these procedures.

11.4 Spare Parts

Critical spare parts are maintained by TRC and the laboratory for field and analytical equipment, respectively. These spare parts will be stored for availability and used in order to reduce equipment downtime.

12.0 CORRECTIVE ACTION

12.1 Introduction

The acceptance limits for sampling and analyses under this program will be those stated in the method or defined by other means in the NEESA-approved laboratory QA/QC Plan. Corrective actions are often immediate in nature, implemented by the analyst or Project Manager. The corrective action usually involves recalculation, reanalysis, or repeating sample collection.

12.2 Immediate Corrective Action

If an immediate corrective action can be taken, as part of normal operating procedures, the collection of poor quality data can be avoided. Instrument and equipment malfunctions are amenable to this type of action. QC procedures include troubleshooting guides and corrective action suggestions. The actions taken will be noted in field or laboratory notebooks, but no other formal documentation is required, unless further corrective action is necessary. These on-the-spot corrective actions are an everyday part of the QA/QC system.

Corrective action during the field sampling portion of a program is most often a result of equipment failure or an operator oversight and may require repeating a sampling run. Operator oversight is best avoided by having field crew members audit each others' work before and after a sampling event. Every effort will be made by the field team leader to ensure that all QC procedures are followed. If potential problems are not solved as an immediate corrective action, TRC will apply formalized long-term corrective action, if necessary.

Corrective action for analytical work will include recalibration of instruments, reanalysis of known QC samples and, if necessary, reanalysis of actual field samples. Specific QC procedures and checklists are used by the laboratory to help analysts detect the need for corrective action. Often the person's experience will be valuable in alerting the operator to suspicious data or malfunctioning equipment.

12.3 Long-Term Corrective Action

The need for long-term corrective action may be identified by standard QC procedures, control charts, performance or system audits. Any quality problem

which cannot be solved by immediate corrective action falls into the long-term category. The TRC QA system ensures that the quality problem is reported to a person responsible for correcting it, and who is part of a closed-loop action and follow-up plan.

The essential steps in the closed-loop corrective action system are listed below:

- Identify and define the problem;
- Assign responsibility for investigating the problem;
- Investigate and determine the cause of the problem;
- Determine a corrective action to eliminate the problem;
- Assign and accept responsibility for implementing the corrective action;
- Establish effectiveness of the corrective action and implement it;
and
- Verify that the corrective action has eliminated the problem.

Documentation of the problem is important to the system. A Corrective Action Request Form (see Figure 3) is filled out by the person finding the quality problem. This form identifies the problem, possible causes, and the person responsible for action on the problem. The responsible person may be an analyst, a field team leader, the QA/QC Manager, the QC Coordinator, or the QA Officer. If no person is identified as responsible for action, the QA Officer investigates the situation and determines who is responsible in each case.

The Corrective Action Request Form includes a description of the corrective action planned and the date it was taken, and space for follow-up. The QA Officer checks to be sure that initial action has been taken and appears effective and, at an appropriate later date, checks again to see if the problem has been fully solved. The QA Officer receives a copy of all Corrective Action Forms and enters them in the Corrective Action Log. This permanent record aids the QA Officer in follow-up and makes any quality problems visible to management. The log may also prove valuable in listing a similar problem and its solution.

12.4 Out-of-Control Events and Corrective Action

Procedures are outlined below as to what corrective action will be taken if an "out-of-control" event occurs, and how it is documented and used to improve laboratory performance. The documentation is easily used by all personnel and is part of routine laboratory procedure. It is recognized that several levels of "out-of-control" events may occur. Three examples of "out-of-control" events are given below along with appropriate corrective actions:

1. Observations Corrected by Analyst at the Bench--The calibration of an instrument is not linear. The analyst finds this and corrects it prior to continuing to analyze samples. The laboratory documents this event and notes that the corrective action was to recalibrate, and that no samples were affected as none were analyzed prior to calibration.
2. Corrective Actions Taken by Supervisor--A matrix spike recovery is out-of-control and the laboratory supervisor finds this after the samples for the day have been analyzed. The supervisor documents that the laboratory blank spiked with surrogates or standards was in control and that other sample spikes were in control, therefore, no re-analysis of the sample is required.
3. Corrective Actions at the Receiving Level--The sample container is broken. The analyst notes this and documents whether or not more sample is available. If no more sample is available, TRC is notified and the decision documented.

13.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

13.1 Internal TRC Reports

The Project QC Coordinator will provide monthly reports of QC activities for the TRC QA Officer and QA/QC Manager. These reports detail the results of quality control analysis, problems encountered, and any corrective action required.

All Corrective Action Forms will be submitted to the TRC QA Officer for initial approval of the corrective action planned. A copy will be provided to the appropriate technical division manager. All system audit reports will be provided to the Project Manager, Division Manager, and Corporate President.

13.2 Laboratory Reports

The laboratory QC Coordinator prepares written quarterly reports on QC activities for the laboratory Technical Director and QA Manager. These reports detail the results of QA procedures, problems encountered, and any corrective action which may have been required. All Corrective Action Forms are submitted to the QA Manager for initial approval of the planned corrective action, and a copy is provided to the Technical Director. All system audit reports are provided to the Technical Director.

Each data transmittal contains a summary of QA/QC activities; this summary will include:

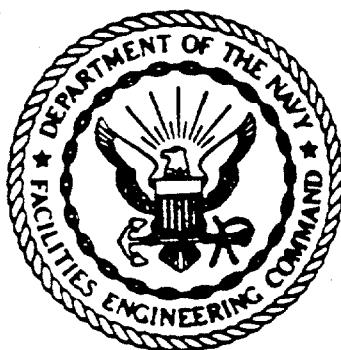
- Estimates of precision, accuracy and completeness of data;
- Reports of performance and system audits;
- Quality problems; and
- Corrective actions.

The final data report to TRC will include a summary of QA/QC activities during the project. The QC Coordinator and QA Manager will participate in preparing this report. The summary of QA/QC results for the analytical work conducted for NETC-Newport will be included in the final RI Report.

13.3 Reports to the U.S. Navy Northern Division

The status of ongoing QA/QC activity will be presented in the project progress reports. Monthly progress reports from the laboratory performing the sample analyses will be sent to the Navy's engineer-in-charge and NEESA QA/QC contract representative as required for the continuing approval of all NEESA-approved laboratories. The final RI report for the project will include a section summarizing the significant findings of all QA/QC activity.

APPENDIX A
NEESA - LEVEL C
GUIDANCE DOCUMENT



JUNE 1988

**SAMPLING AND CHEMICAL ANALYSIS QUALITY
ASSURANCE REQUIREMENTS FOR THE NAVY
INSTALLATION RESTORATION PROGRAM**

NEESA 20.2-047B



**NAVAL ENERGY AND ENVIRONMENTAL
SUPPORT ACTIVITY**

Port Hueneme, California 93043

NOT FOR PUBLIC RELEASE



Table 7.6. Data set deliverables for Level C QA

Method requirements	Deliverables
Organics - Method blank spikes with results and control charts. Run with each batch of samples processed.	Control chart
- Results to be reported on CLP Form 1 or spreadsheet per Sect. 9. Sample results using CLP data flags.	Form 1 or Sect. 9 1/Sample chromatograms/and mass spectra
- Surrogate recovery from samples reported on CLP Form 2. Surrogates to be used in volatiles, semivolatiles, pesticides/PCB. For volatiles by GC, the names of surrogates should be changed to reflect the surrogate used.	Form 2
- Matrix spike/spike duplicate 1 spike and spike duplicate per 20 samples of similar matrix reported on Form 3.	Form 3
- Method blank reported on CLP Form 4. For volatiles by GC, a similar format will be used as CLP Form 4 for blanks.	Form 4 or Sect. 9
- GC/MS tuning for volatiles/semi-volatiles. Report results on Form 5.	Form 5
- Initial calibration data reported on Form 6. For volatiles by GC, the initial calibration data with response factors must be reported.	Form 6 No Form
For pesticide/PCB data Form 9 must be used for calibration data.	Form 9
- Continuing calibration GC/MS data reported on Form 7.	Form 7
For volatiles, GC data, the response factors and their percent differences from the initial must be reported.	No Form
Internal Standard Area for Volatiles and Semivolatiles.	Form 8



Table 7.6. (continued)

Method requirements	Deliverables
Organics - For pesticides/PCB data, the CLP Form 9 (cont'd) must be presented.	Form 9
<p>No chromatograms or mass spectra are presented for calibration. These data should be filed in the laboratory and available if problems arise in reviewing/validating the data. The calibration information should be available for checking during on-site audits.</p>	
- Internal standard area for GC/MS analyses CLP Form VIII shall be supplied.	
- Second column confirmation shall be done for all GC work when compounds are detected above reporting limits. Chromatograms of confirmation must be provided.	Chromatograms
Metals - Level C, requirements	Deliverables
- Sample results with CLP flagging system	CLP Form 1 or Sect. 9
- Initial and continuing calibration	CLP Form 2, Part 1 only
- Blanks 10% frequency	Form 3
- Method blank taken through digestion (1/20 samples of same matrix)	Form 3 or Sect. 9
- ICP interference check sample	Form 4
- Matrix spike recovery (1 per 20 samples of similar matrix)	Form 5, Part 1
- Postdigestion spike sample recovery for ICP metals. Only done if predigest spike recovery exceed CLP limits.	Form 5, Part 2 (never used for GFAA work)
- Postdigest spike for GFAA	Recovery will be noted on raw data
- Duplicates (1 per 20 samples will be split and digested as separate	Form 6 samples



Table 7.6. (continued)

Method requirements	Deliverables
Metals (cont'd) - Method blank spike information will be plotted on control chart, one per batch of samples processed.	Control chart
- Standard addition. The decision process outlined in CLP page E-3 will be used to determine when standard additions are required.	Form 8
Holding times	Form 10
Wet Chemistry Level C	
- Blank spike 1/batch	Control chart
- Method Blank 1/batch	Report result No format
- Sample results	Report result No format
- Matrix spike/spike duplicate or calibration information	Report result if applicable
- Calibration check report percent RSD or percent difference from initial calibration	Report percent or percent difference
	No format

7.3.2 Level C Data Validation Guidelines

Listed below are the validation criteria which will be utilized in evaluating the analytical data for a Level C QC site. For methods not listed here, a similar procedure will be submitted by the prime contractor and the laboratory which outlines validation of the holding times, initial calibration, continuing calibration, and blank-vs-sample results. The validation procedure will be approved by the NCR.

1. For Petroleum Hydrocarbons (418.1/SW-3540, EPA 418.1)

Holding Times - Holding times are 28 days for water samples which are preserved and refrigerated. No holding times are cited for soils.



Calibration - Ensure that a three-to-five point curve bracketing the sample concentration is performed daily.

Blanks - A blank should be run with each batch. If the blank concentration exceeds the reporting limit, the reporting limit shall be raised and the data flagged as estimated (UJ).

2. Target Compound List (TCL) for VOAs (CLP Methods)

Holding Times - Samples must be analyzed within the holding times specified in Sect. 3 or the data should be marked as estimated (J).

GC/MS Tuning - Check that bromofluorobenzene tune is completed each 12-h shift of operation. Check that it meets the CLP criteria. Assure that each sample is associated with a tune.

Initial Calibration - The maximum relative standard deviation [(RSD) percent RSD] shall not be >30% for indicated CLP CCC. The maximum mean relative response factor (RRF) for SPCC shall be >0.300 (0.250 for bromoform). The SPCCs are chloromethane, 1,1-dichloroethane, bromoform, 1,1,2,2-tetrachloroethane, and chlorobenzene. The CCC compounds are vinyl chloride, 1,1-dichloroethene, chloroform, 1,2-dichloropropane, toluene, and ethylbenzene.

Continuing Calibration - The minimum response factor for the SPCC components for VOAs analyses shall not be <0.300 (0.250 for bromoform). The maximum response factor percent deviation for indicated CLP CCC components from the mean initial calibration response factor shall not exceed 25%. If these criteria are exceeded, a new calibration for the compound shall be employed.

Blank/Spike Control Samples - Any control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data analyzed with the out-of-control point shall be discussed in the QC section of the MPR and final report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples within the holding times or the data will be flagged with an "R," and the data are not usable.

Surrogates - If surrogates exceed the CLP limits, the data shall be flagged that the surrogates exceeded limits.

Method Blanks - A method blank should be run each day following the Continuing Calibration Standard. Common laboratory solvents should not be found in the blank at levels over five times the detection





limits. Other compounds should not be found in the blank at levels exceeding the detection limits. If common contaminant compounds are detected in samples at a concentration of <10 times the concentration found in the blank, or other compounds at <5 times the concentration in the blank, report those compounds as not detected. Adjust the sample quantitation limit to the value reported in the samples and flag the limit as estimated (UJ).

Matrix Spike/Spike Duplicate - Ensure that 1 out of 20 samples has been spiked in duplicate. The recoveries shall meet the CLP criteria. If the recoveries do not meet the criteria, examine the blank spike data. If the blank spike data exceed the limits and the matrix spikes exceed limits, the data shall be flagged as unusable (R). If the blank spike data from the batch are satisfactory, the data is usable, and the low recovery is discussed in the final report QA/QC and in the QC report sent to the NCR.

Field Trip and Equipment Blanks - If contaminant analytes are detected in samples at concentrations of <5 times the concentration found in the highest associated blank, the results are considered suspect and are reported as estimated.

3. TCL Semivolatile Organics (CLP Methods)

Holding Times - Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction. Any samples which do not meet these requirements must be flagged as estimated.

GC/MS Tune - Make certain that a decafluorotriphenylphosphine tune is completed every 12 h of sample analysis, that each sample is associated with a tune, and that each tune meets CLP requirements. Data are not reported if the instrument does not meet tune.

Initial Calibration - Ensure that a 5-point curve has been completed. The RRF of the BNA compounds shall be a minimum of 0.050 for the SPCC listed in the current revision of the CLP. The maximum RSD for the CCC listed in the CLP procedure is 30.0%. The minimum RRF for the SPCC is 0.050, and the maximum percent difference for the CCC is 25%. If these limits are exceeded, a new calibration curve shall be generated.

Continuing Calibration - The continuing calibration check will be performed once every 12 h during operation. The minimum RRF for the SPCC is 0.05, and the maximum percent difference from the initial calibration shall not exceed 25% for the CCC. If these limits are exceeded, a new calibration curve shall be generated.

Blank/Spike Control Samples - Any control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data and the out-of-control point shall be discussed in the QC section of

the report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples or the data will be flagged with an "R," and the data is not usable.

Surrogates - If surrogates exceed the CLP limits, the data shall be flagged that the surrogates exceeded limits.

Blanks - A method blank should be run each day following the Continuing Calibration Standard. Phthalate should not be found in the blank at levels over five times the detection limits. Other compounds should not be found in the blank at levels exceeding the detection limits. If common contaminant compounds are detected in samples at a concentration of <10 times the concentration found in the blank, or other compounds at <5 times the concentration in the blank, report those compounds as not detected. Adjust the sample quantitation limit to the value reported in the samples and flag the limit as estimated (UJ).

Matrix Spike/Spike Duplicate - Ensure that 1 out of 20 samples has been spiked in duplicate. The recoveries should meet the CLP criteria. If the recoveries do not meet the criteria, examine the blank spike data. If the blank spike data exceed the limits and the matrix spikes exceed limits, the data shall be flagged as unusable (R). If the blanks spike data from the batch is satisfactory, the data are usable, and the low recovery is discussed in the final QC report sent to the Analytical Environmental Support Section.

4. Metals

Holding Times - Samples must be analyzed within six months, except mercury shall be analyzed in 28 days from sample collection.

ICP Initial Calibration - A calibration blank and at least one standard must be analyzed daily. An initial calibration verification standard must be within 90 to 110% recovery or the samples should be reanalyzed. If it is not possible to perform reanalysis, the data are rejected and flagged with an "R."

AA Calibration - Calibration blank and at least three standards shall be used in establishing the curve prior to sample analysis. A curve shall be analyzed each day prior to sample analysis.

Calibration Verification - Verification using a standard obtained from a source other than that of the initial calibration shall be used and the result shall be within 90 to 110% of the true value for



both ICP and AA work. Calibration verification shall be done at a minimum frequency of 10% or every 2 h, whichever is more frequent, and shall be done at the end of the analytical run.

Method Blanks - At least one preparation blank shall be prepared with each batch of samples. The blanks shall contain less than the detection limit for all analytes. If the concentration of the associated blanks is above the detection limit and if the lowest analyte concentration is <10 times the blank, reanalysis of the sample must occur. If reanalysis is not done, the data shall be reported and flagged as estimated. The blank shall never be subtracted from the sample.

Field and Equipment Blanks - If contaminant analytes are detected in samples at concentrations of <5 times the concentration found in the highest associated blank, the results are considered suspect and are reported as estimated.

Blank/Spike Laboratory Control Samples - Any laboratory control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data and out-of-control point shall be discussed in the QC section of the report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented. A discussion of data reported when the blank/spike laboratory control sample is out of control shall be presented in the QC section of both the final report and the MPR.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples or the data will be flagged with an "R," and the data are not usable.



APPENDIX B

FIELD INSTRUMENT CALIBRATION PROCEDURES

FIELD INSTRUMENTATION CALIBRATION PROCEDURES

HNu CALIBRATION PROCEDURE (PI-101)

1. Run through start up procedures as per manufacturer's directions.
2. Connect a sampling hose to the regulator outlet and the other end to the sampling probe of the HNu.
3. Crack the regulator valve.
4. Take reading after 5 to 10 seconds.
5. If the reading deviates +15 percent from the concentration of the calibration gas, the instrument requires maintenance.
6. Each office must develop a mechanism for the documentation of calibration results. This documentation includes:
 - a. Date inspected.
 - b. Person who calibrated the instrument.
 - c. The instrument number (Serial # or Other ID #)
 - d. The results of the calibration (ppm, probe ev, span pot setting).
 - e. Identification of the calibration gas (source, type, concentration lot #),

CALIBRATION METHOD FOR ORION MODEL 399A pH METER

1. Turn on pH meter and check battery.
2. Turn function switch to pH position.
3. Select two buffer solutions; one buffer solution shall be pH 7. Choose a second buffer so that the two solutions bracket the anticipated sample pH.
4. Place pH electrode into pH 7 buffer solution.
5. Turn calibration control until the meter needle points to the pH value of the buffer.

6. Remove the electrode from the pH 7 buffer and rinse with distilled water.
7. Place electrode into the second pH buffer solution (pH 4 or pH 10).
8. Turn the temperature compensator knob until the meter needle points to the pH value of the buffer solution (pH 4 or pH 10).
9. Measure the temperature of the second buffer solution.
10. Turn the slope indicator until the arrow of the temperature compensator points to the actual temperature of the buffer. The percent of the theoretical slope can be read on the slope scale. A slope of less than 90 percent may be caused by a defective electrode or contaminated buffer. If a slope of less than 90 percent is obtained, correct problem before proceeding.
11. Remove electrode from buffer and rinse thoroughly with distilled water.
12. Measure the temperature of a fresh grab sample.
13. Turn the slope indicator until the arrow of the temperature compensator points to the temperature of the solution.
14. Place the electrode into the sample, swirl and read pH value. In case of the low specific conductance and meter drift, add 1 ml of 1M KCl solution to each 100 ml of sample, swirl sample and read pH.
15. Turn off meter after last reading.
16. Rinse electrode and store in rubber cap with distilled water.
17. All standards should be traceable to NBS Standard via lot #s.

CALIBRATION METHOD FOR SPECIFIC CONDUCTANCE METER

1. Turn on conductivity meter and check battery.
2. Use prepared standard solution of potassium chloride (KCl) 1,413 umhos/cm.
3. Set temperature dial to the temperature of the standard KCl solution.
4. Turn meter to the appropriate scale for the KCl standard and insert probe into KCl solution.

5. Adjust calibration mode until the conductivity measures 1,413 umhos/cm.
6. Remove probe from standard solution and rinse with distilled water.

MERCURY THERMOMETERS

Mercury thermometers are calibrated by the manufacturer.

damaging the batteries. When finished, move the battery charger switch to OFF and disconnect from the Side Pack Assembly.

The following are special instructions relative to batteries which have been allowed to completely discharge.

It has been established that the above battery recharging procedures may not be sufficient when the operator of the instrument has inadvertently left the INSTR Switch ON for a period of time without recharging and allowed the battery to completely discharge.

When this happens and the above procedures fail to recharge the battery, the following should be accomplished:

- 1) Remove the battery from the instrument case.
- 2) Connect to any variable DC power supply.
- 3) Apply 40 volts at 1/2 amp maximum.
- 4) Observe the meter on the power supply frequently and as soon as the battery begins to draw current, reduce the voltage on the power supply at a slow rate until the meter reads approximately 15 volts. NOTE: The time required to reach the 15 volt reading will depend on degree of discharge.
- 5) Repeat steps a), b), c), and d) above to continue charging.

2.7.2 DC CHARGER

- a) The optional DC charger is designed to both charge the battery and to provide power for operating the instrument from a 12 volt DC source, such as vehicle power.
- b) Connect the DC charger cord to the connector on the battery cover of the Side Pack Assembly. Plug the line cord into the vehicle cigarette lighter or other power source connection.
- c) In mobile applications, the DC charger is used to supply vehicle power to the instrument. Therefore, it may be left connected at all times.

2.8 CHARCOAL FILTERING

When it is desired to preferentially remove the heavier hydrocarbons, such as those associated with automobile exhaust, gasoline, etc., simply remove the pickup fixture from the end of the probe and install the optional charcoal filter assembly.

This same charcoal filter assembly can be installed directly into the Readout Assembly by using the adapter provided.

2.9 MOISTURE FILTERING

Filtering of moisture in the sample is not normally required. However, when moving in and out of buildings in cold weather, excessive condensation can form in the lines and detector chamber. In this case, the charcoal filter adapter can be filled with a desiccant such as "Drierite" which will filter out the moisture contained in the sample.

SECTION 3

SUMMARIZED OPERATING PROCEDURES

3.1 GENERAL

The procedures presented in this section are intended for use by personnel generally familiar with the operation of the instrument. Section 2 presents the comprehensive detailed operating procedures.

It is assumed that, prior to start up the positions of all switches and valves are in shut down configuration as described in paragraph 3.3.

3.2 START UP

- a) Move PUMP Switch to ON and check battery condition by moving the INSTR Switch to the BATT position.
- b) Move INSTR Switch to ON and allow five (5) minutes for warm-up.
- c) Set Alarm Level Adjust Knob on back of Readout Assembly to desired level.
- d) Set CALIBRATE Switch to X10 position, use CALIBRATE Knob and set meter to read 0.
- e) Move PUMP Switch to ON position then place instrument panel in vertical position and check SAMPLE FLOW RATE indication.
- f) Open the H2 TANK VALVE and the H2 SUPPLY VALVE.
- g) Depress Igniter Button until burner lights. Do not depress Igniter Button for more than six (6) seconds. (If burner does not ignite, let instrument run for several minutes and again attempt ignition.)
- h) Use CALIBRATE Knob to "zero" out ambient background. For maximum sensitivity below 10 ppm, set CALIBRATE Switch to X1 and readjust zero on meter. To avoid false flame-out alarm indication, set meter to 1 ppm with CALIBRATE Knob and make differential readings from there.

3.3 SHUT DOWN

- a) Close the H2 SUPPLY VALVE and the H2 TANK VALVE.
- b) Move the INSTR Switch and PUMP Switch to OFF.
- c) Instrument is now in shut down configuration.

SECTION 4

CALIBRATION

4.1 GENERAL

The OVA is capable of responding to nearly all organic compounds. For precise analyses it will be necessary to calibrate the instrument with the specific compound of interest. This is especially true for materials containing elements other than carbon and hydrogen.

The instrument is factory calibrated to a methane in air standard. However, it can be easily and rapidly calibrated to a variety of organic compounds. A GAS SELECT control is incorporated on the instrument panel which is used to set the electronic gain to a particular organic compound.

Internal electronic adjustments are provided to calibrate and align the electronic circuits. There are four (4) such adjustments all located on the electronic board. One adjustment potentiometer, R-38, is used to set the power supply voltage and is a one-time factor adjustment. The remaining three adjustments, R-31, R-32 and R-33 are used for setting the electronic amplifier gain for each of the three (3) calibrate ranges. Access to the adjustments is accomplished by removing the instrument from its case. Figure 4-1 indicates the location of the adjustments.

4.2 ELECTRONIC ADJUSTMENTS

Primary calibration of this instrument is accomplished at a factory using methane in air sample gases.

4.2.1 GAIN ADJUSTMENT

- Place instrument in normal operation with CALIBRATE Switch set to X10 and GAS SELECT control set to 300.
- Use the CALIBRATE ADJUST (zero) Knob and adjust the meter reading to zero.
- Introduce a methane sample of a known concentration (near 100 ppm) and adjust trimpot R-32 on circuit board (see Figure 4-1 for location) so that meter reads equivalent to the known sample.
- This sets the instrument gain for methane with the panel mounted gain adjustment (GAS SELECT) set at a reference number of 300.
- Turn off H2 SUPPLY VALVE to put out flame.

4.2.2 BIAS ADJUSTMENT

- Leave CALIBRATE Switch on X10 position and use CALIBRATE ADJUST (zero) Knob to adjust meter reading to 4 ppm.
- Place CALIBRATE Switch in X1 position and, using trimpot R-31 on circuit board, adjust meter reading to 4 ppm. (See Figure 4-1)
- Move CALIBRATE Switch to X10 position again. Use CALIBRATE ADJUST (zero) Knob to adjust meter to a reading of 40 ppm.
- Move CALIBRATE Switch to X100 position and use trimpot R-33 on circuit board to adjust meter reading to 40 ppm.
- Move CALIBRATE Switch to X10 position and use CALIBRATE ADJUST (zero) Knob to adjust meter reading to zero.
- Unit is now balanced from range to range, calibrated to methane, and ready to be placed in normal service.

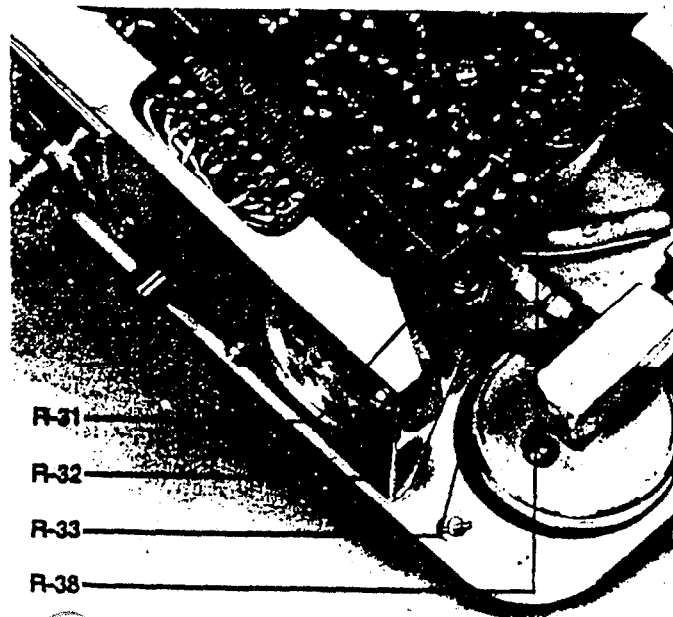


FIGURE 4-1. LOCATION OF ELECTRONIC ADJUSTMENTS

Model OVA-118 shown; location typical to OVA-128)

4.3 CALIBRATION TO OTHER ORGANIC VAPORS

4.3.1 SETTING GAS SELECT CONTROL (Span)

Primary calibration of the instrument is accomplished using a known mixture of a specific organic vapor compound. After the instrument is in operation and the "normal background" is "zeroed out", draw a sample of the calibration gas into the instrument. The GAS SELECT Knob on the panel is then used to shift the readout meter indication to correspond to the concentration of the calibration gas mixture.

The instrument is then calibrated for the vapor mixture being used. After this adjustment, the setting on the "digital" is read and recorded for that particular organic vapor compound. This exercise can be performed for a large variety of compounds and when desiring to read a particular compound the GAS SELECT control is turned to the predetermined setting for the compound. Calibration on any one range automatically calibrates the other two ranges.

4.3.2 USING EMPIRICAL DATA

Relative response data may be obtained, which can then be used to estimate concentrations of various vapors. With the instrument calibrated to methane, obtain the concentration reading for a calibration sample of the test vapor. The relative response, in percent, for that test vapor would then be the concentration read/concentration of the calibrated sample X 100.

4.3.3 PREPARATION OF CALIBRATION STANDARDS

4.3.3.1 COMMERCIAL SAMPLES

Commercially available standard samples offer the most convenient and reliable calibration standards and are recommended for the most precise analyses. Always remember to obtain the cylinder with the desired sample and the "balance as air". Sample should be drawn from the cylinder into a collapsed sample bag, then drawn from the bag by the instrument to prevent a pressure or vacuum at the sample inlet.

4.3.3.2 PURE GASEOUS SAMPLES

Obtain a large collapsible sample bag, preferably polyethylene such as a 40 gallon trash can liner. Insert a tube into the bag opening and tie shut around the tube. The tubing should have a shut-off valve or plug and be suitable for connecting the OVA input tube. Determine the volume of the bag by appropriate means (i.e., wet-test meter, dimensions of the bag, etc.). Forty gallon polyethylene bags provide a volume of approximately 140-160 liters. For gas samples, flush a 10 cc hypodermic syringe with the compound to be tested and then inject a 10 cc sample through the wall of the air-filled bag. Immediately after withdrawing the needle, cover the hole with a piece of plastic tape. Allow a few minutes for the sample to completely diffuse throughout the bag. Agitation will ensure complete diffusion. Connect the outlet tube to the OVA and take a reading. To verify repeatability of sampling technique, disconnect the bag and inject a second sample of the gas into the bag without emptying. Since only 2 or 3 liters will have been removed, the overall volume change will be small and the instrument reading should now be twice that of the

original. The concentration in ppm (V/V) will be equal to the sample size in cc divided by the volume of the bag in liters times 1000. For example, a 10 cc gas sample when placed in a 160 liter bag will provide a sample of 63 ppm, $10 \times 1000/160$ equals 63 ppm.

4.3.3.3 GASEOUS AND LIQUID SAMPLES (Alternate Method)

Obtain a five (5) gallon glass bottle and determine its volume by measuring the volume of water needed to fill it (use of a 1000 ml graduated cylinder, obtainable from scientific supply houses, is convenient). Another approach is to weigh the empty bottle, fill it with water and weigh again. The difference between the two values is the weight of water. By multiplying the weight of water in pounds by 0.455, you obtain the volume of the bottle in liters. Empty the water out and allow the bottle to dry. Place a one-foot piece of plastic tubing in the flask to aid in mixing the vapors uniformly with the air. The volume of such a bottle should be about 20 liters, which is 20,000 ml. If the volume were 20,000 ml, then a 2 ml sample of a gas placed in the bottle would be equivalent to 200 ml per 2 million ml or 100 ppm (V/V). Use of a gas tight syringe, readable in 0.01 ml, allows the preparation of mixtures in the 1 - 2 ppm range, which are sufficient for the quantitative estimation of concentrations. A rubber stopper is loosely fitted to the top of the bottle and the needle of the syringe placed inside the jug neck and the stopper squeezed against the needle to decrease leakage during sample introduction. Inject the sample into the bottle and withdraw the needle without removing the stopper. Put the stopper in tight and shake the bottle for a few minutes with sufficient vigor that the plastic tubing in the bottle moves around to ensure a mixture of the vapors with the air.

For liquid samples, use of the following equation will allow the calculation of the number of microliters of organic liquid needed to be placed into the bottle to make 100 ppm (V/V) of vapor.

$$V1 \text{ equals } V2 \times Mw / 244D$$

V1 - Volume of liquid in microliters needed to make an air mixture of 100 ppm (V/V)

V2 - Volume of bottle in liters

Mw - Molecular weight of substance

D - Density of substance

This procedure has the advantage that you can see when all of the organic liquid has vaporized and the volume can be determined readily.

For liquid samples, an alternate procedure involves the use of a diffusion dilution device such as that described by Desty, Geach and Goldup in "Gas Chromatography", R.P.W. Scott, ed., Academic Press, New York, 1961.

4.4 THEORY

Theoretical background and empirical data related to the Century Organic Vapor Analyzer is presented in 4.4.1 and 4.4.2.

4.4.1 HYDROCARBONS

In general, a hydrogen flame ionization detector is more sensitive for hydrocarbons than any other class of organic compounds. The response of the OVA varies from compound to compound, but gives excellent repeatable results with all types of hydrocarbons; i.e., saturated hydrocarbons (alkanes), unsaturated hydrocarbons (alkenes and alkynes) and aromatic hydrocarbons.

The typical relative response of various hydrocarbons to methane is as follows:

Compound	Relative Response (percent)
Methane	100 (reference)
Propane	64
N-butane	61
N-pentane	100
Ethylene	85
Acetylene	200
Benzene	150
Toluene	120
Ethane	90

4.4.2 OTHER ORGANIC COMPOUNDS

Compounds containing oxygen, such as alcohols, ethers, aldehydes, carboxylic acid and esters give a somewhat lower response than that observed for hydrocarbons. This is particularly noticeable with those compounds having a high ratio of oxygen to carbon such as found in the lower members of each series which have only one, two or three carbons. With compounds containing higher numbers of carbons, the effect of the oxygen is diminished to such an extent that the response is similar to that of the corresponding hydrocarbons.

Nitrogen-containing compounds (i.e., amines, amides and nitriles) respond in a manner similar to that observed for oxygenated materials. Halogenated compounds also show a lower relative response as compared with hydrocarbons. Materials containing no hydrogen, such as carbon tetrachloride, give the lowest response; the presence of hydrogen in the compounds results in higher relative responses. Thus, CHCl_3 gives a much higher response than does CCl_4 . As in the other cases, when the carbon to halogen ratio is 5:1 or greater, the response will be similar to that observed for simple hydrocarbons.

The typical relative response of various compounds to methane is as follows:

Methane	100 (calibration sample)
Ketones	
Acetone	60
Methyl ethyl ketone	80
Methyl isobutyl ketone	100
Alcohols	
Methyl alcohol	15
Ethyl	25
Isopropyl	65

Halogen compounds

Carbon tetrachloride	10
Chloroform	65
Trichloroethylene	70
Vinyl chloride	35

The OVA has negligible response to carbon monoxide and carbon dioxide which evidently, due to their structure, do not product appreciable ions in the detector flame. Thus, other organic materials may be analyzed in the presence of CO and CO₂.

V. OPERATING PROCEDURE

The Model 260 should be checked and "zeroed" in an uncontaminated atmosphere. Refer to Figure 1 and use the following procedure.

1. Open the instrument lid. Turn the center ON-OFF control to the far right HORN-OFF position. Both meter pointers will move and one or both alarm lights may light.
2. If the % oxygen meter pointer stabilizes at a value other than 20.8%, the pointer should be set to 20.8% by using the CALIBRATE O₂ control.
3. The % LEL meter pointer should be set to zero by adjusting the ZERO LEL control.
4. If either the alarm lights are lighted press the Alarm Reset button.
5. Momentarily place a finger over the sample inlet fitting or the end of the sample line probe. Observe that the flow indicator float drops out of sight indicating no flow. If the float does not drop, check out the flow system for leaks as described under Section VII.
6. Press the CHECK button and observe the % LEL meter. The pointer must read at 80% LEL or higher as marked by the BATTERY zone on the meter. If the pointer reading is less, the batteries must be recharged. No tests should be attempted as the instrument will not perform properly. See Section VI for battery charging instructions.
7. If it is desired that the audible alarm sound for combustible gas or low oxygen concentrations, turn the center ON-OFF control back one position to the ON setting.
8. Accessory equipment such as sampling lines, probes, carrying harness, filters or line traps should be attached as required. See Figure 2.
9. The instrument is ready for atmospheric sampling.

VI. MAINTENANCE AND CALIBRATION

Battery Service

The primary maintenance item of the Model 260 is the rechargeable 2.4 volt nickel cadmium (Ni-Cd) battery (Figure 7). The battery is recharged by simply removing the screw cap covering receptacle and connecting one end of the charging cable to the instrument and the other end to a 115V ac outlet.

If desired, the battery can be recharged from a 12V dc source. An accessory battery charging cable is available, one end of which plugs into the Model 260 while the other end is fitted with an automobile cigarette lighter plug.

Recommended charging time is 16 hours. It may be left on charge for longer periods without damaging the battery.

CAUTION: RECHARGING MUST BE DONE IN A NON-HAZARDOUS LOCATION.

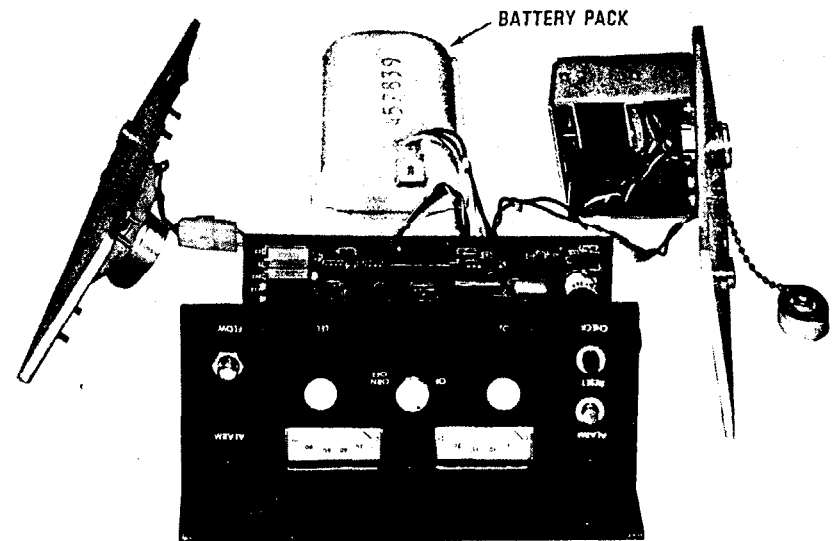


FIGURE 7 — DISASSEMBLY SHOWING BATTERY PACK

The batteries sometimes will not supply full power capacity after repeated partial use between chargings. For this reason, it is recommended that the batteries be "exercised" at least once monthly. Run the Model 260 for 8 to 10 hours and then recharge.

If the instrument has not been used for 30 days, the batteries should be charged prior to use.

Should the battery not respond to recharging or not "hold" a charge, the battery should be replaced. Replacement procedure is as follows:

1. Loosen the knurled screws holding the handle and remove the handle.
2. Looking at the front panel of the instrument, remove the right side (audible alarm side panel) by unscrewing the four side panel screws.
3. Gently pull the side panel loose and tilt the instrument to help the battery case slide out. Disconnect the molded nylon plug.
4. Install new battery in the reverse procedure outlined above.

Calibration

Before the calibration of the combustible gas indicator can be checked, the Model 260 must be in operating condition as described in the OPERATING PROCEDURE, Section V. Optional calibration equipment is shown in Figure 8. Calibration check-adjustment is made as follows:

1. Attach the flow control to the recommended calibration gas tank.
2. Connect the adapter-hose to the flow control.
3. Open flow control valve.
4. Connect the adapter-hose fitting to the inlet of the instrument; after about 15 seconds the L.E.L. meter pointer should be stable and within the range specified on the calibration sheet accompanying the calibration equipment. If the meter pointer is not in the correct range, stop the flow, remove the right hand side cover. Turn on the flow and adjust the "S" control with a small screwdriver to obtain a reading as specified on the calibration sheet.
5. Disconnect the adapter-hose fitting from the instrument.
6. Close the flow control valve.
7. Remove the adapter-hose from the flow control.
8. Remove the flow control from the calibration gas tank.
9. Replace the side cover on the Model 260.

CAUTION: Calibration gas tank contents are under pressure. Use no oil, grease or flammable solvents on the flow control or the calibration gas tank. Do not store calibration gas tank near heat or fire or in rooms used for habitation. Do not throw in fire, incinerate or puncture. Keep out of reach of children. It is illegal and hazardous to refill this tank. Do not attach the calibration gas tank to any other apparatus than described above. Do not attach any gas tank other than MSA calibration tanks to the regulator.

Printed Circuit Board Adjustments

The printed circuit board contains six adjustment pots as shown in Figure 9. These are identified as:

Combustible Gas Indicator

- CZ — coarse zero is adjusted by setting the ZERO L.E.L. control at mid-range; sampling fresh air and adjusting the % L.E.L. meter to read zero.
- S — span is adjusted after proper zeroing by sampling calibration gas and adjusting the read-out accordingly.
- CHK — this controls the battery charge indication and should read at "B" in the word BATTERY on the meter face when the battery voltage measured with a voltmeter is 2.40V.
- CGA — the combustible gas alarm point is factory set at 50% L.E.L.

Oxygen Indicator

- OA — the oxygen alarm point adjustment. It is factory set at 19.5% oxygen.
- OT — oxygen trim is factory adjusted with the instrument turned on to obtain a zero reading on the oxygen meter when sampling a pure inert gas (100% nitrogen).

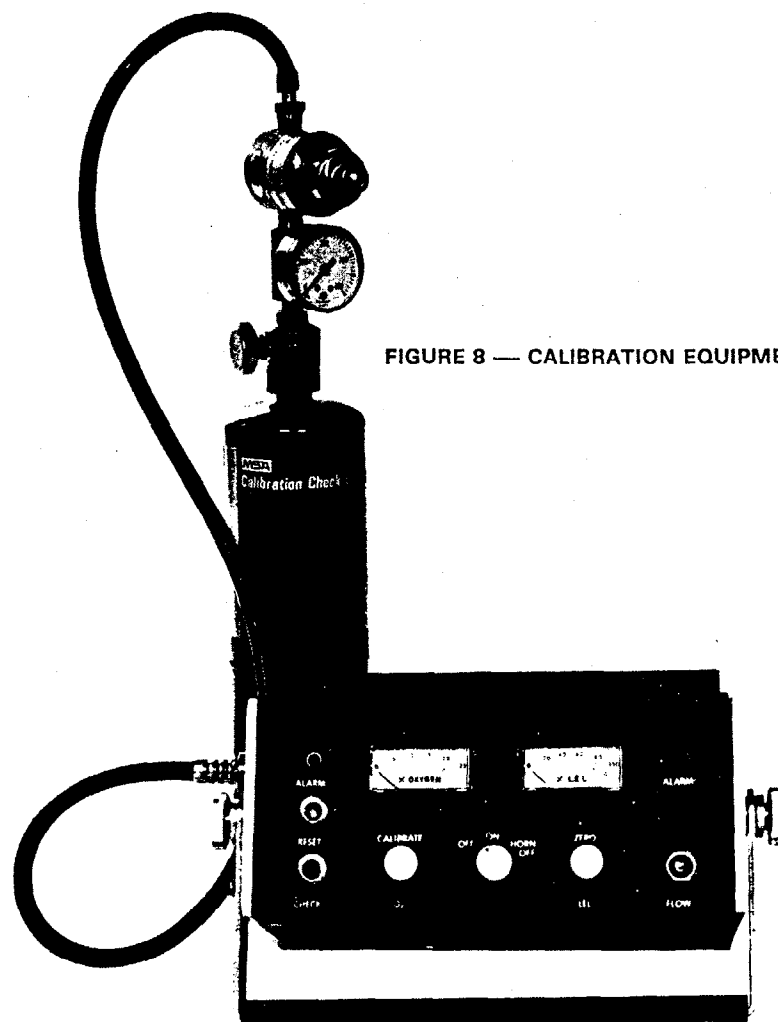


FIGURE 8 — CALIBRATION EQUIPMENT

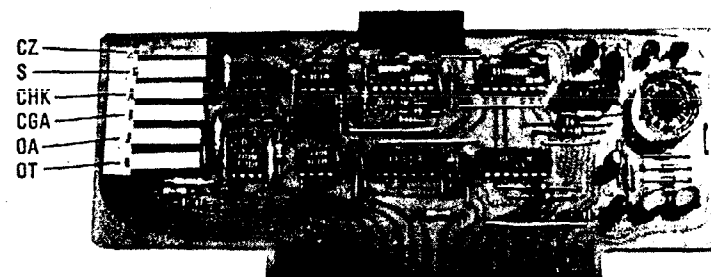


FIGURE 9 — PRINTED CIRCUIT BOARD ADJUSTMENTS

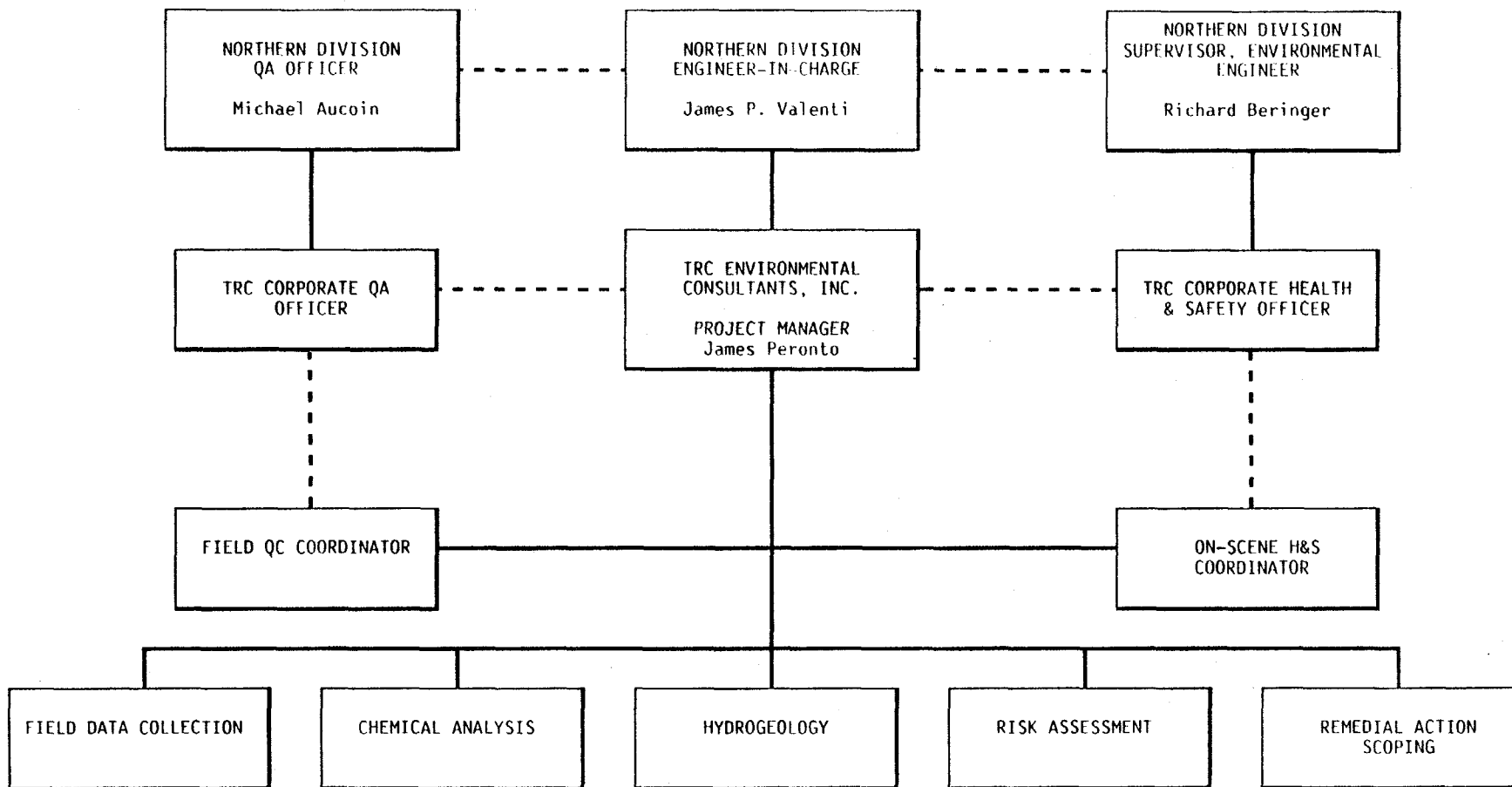
PORTABLE GAS CHROMATOGRAPH CALIBRATION PROCEDURES

Since the gas chromatograph is not a direct read-out instrument and instrument response can be checked by running standards and comparing retention times at different times, calibrations should be performed frequently by running standards. Instrumental calibration will be done at the beginning and end of each day, as well as once for every ten (10) samples analyzed. The identity of the standards is typically comprised of aromatic hydrocarbon(s) (e.g., benzene, toluene, xylenes and ethyl benzene) and chlorinated hydrocarbons (e.g., tetrachloroethylene, trichloroethylene), and is usually tailored to site-specific conditions and contaminants of concern. The concentrations of the standards are usually chosen to match expected field conditions.

The instrument calibration will be performed as follows:

- Prepare or obtain an appropriate standard for air analysis;
- Withdraw an aliquot of headspace gas with a syringe for injection or directly inject a factory calibration gas that will result in chromatograph peaks that are large enough to see and not so large that they do not fit on the chart paper;
- Compare peaks of identical standard injections made before, during, and after analyses conducted throughout the day; and
- If peak heights of the above standard injections change significantly, note the sensitivity lost or gained on the chart paper and include this information on the resulting report.

FIGURES



TRC

**Environmental
Consultants**

800 Connecticut Boulevard
East Hartford, Connecticut 06108
(203) 289-8631

NAVAL EDUCATION TRAINING CENTER NEWPORT, RI

FIGURE 1.
PROJECT ORGANIZATION –
REMEDIAL INVESTIGATION

CHAIN OF CUSTODY RECORD

PROJECT NO.		PROJECT NAME						PARAMETERS								Nº	2043			
SAMPLERS: (Signature)					(Printed)															REMARKS
FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION															

Relinquished by: (Signature)	Date / Time	Received by: (Signature)
(Printed)		(Printed)

Relinquished by: (Signature)	Date / Time	Received by: (Signature)
(Printed)		(Printed)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)
(Printed)		(Printed)

Date / Time	Remarks

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

FIGURE 2. CHAIN OF CUSTODY RECORD

CORRECTIVE ACTION REQUEST FOR NO. _____

PROJECT MANAGER: _____

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

RI/FS WORK PLAN
FOR THE
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared for:

Northern Division - Naval Facilities
Engineering Command
Philadelphia, PA

VOLUME IV
DATA MANAGEMENT PLAN

March 1989

TRC Project No. 5383-N81-30
Contract No. N62472-86-C-1282

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1.0 INTRODUCTION

EPA's CERCLA guidance calls for stringent data management procedures for field activities, sample management and tracking, and document control and inventory. Appropriate procedures currently in place at TRC and the laboratory will be applied to meet these requirements as described below.

2.0 FIELD DATA COLLECTION AND RECORDING

During field sampling, consistent documentation and accurate recordkeeping procedures are critical. Data management procedures for field sampling at NETC-Newport includes the following:

- Quality Assurance/Quality Control (QA/QC) Plan -- Provides procedures and protocols for records responsibility, nonconformity events, corrective measures, and data deficiencies. The QA/QC Plan for NETC-Newport appears in Section 4 of this Work Plan.
- Data Security System and Chain-of-Custody -- The QA/QC Plan describes strict chain-of-custody procedures which will be followed in the field and through sample analysis at the laboratory. Chain-of-custody records and shipping airbills will be maintained in a locked file cabinet at the TRC field office at NETC-Newport. At the completion of field work, chain-of-custody records will be transferred to the central project file at TRC's East Hartford, CT, office.
- Field Logs -- Daily field logs maintained by the field team leader will be the primary record for field investigation activities. Field logs will include a description of any modifications to the procedures outlined in the work plan, field sampling plan, or health and safety plan, with justifications for such modifications. Field measurements and observations will be recorded directly into the project log books. Examples of field measurements include pH, temperature, conductivity, ground water elevation, air quality parameters, and soil characteristics.

Health and safety monitoring, sampling locations, sampling techniques, and a general description of daily activity are typically included in the daily log. Any unusual occurrences or circumstances will be documented in these logs for reference in determining the possible causes for data anomalies discovered during data analysis. Data will be recorded directly and legibly in field log books with entries signed and dated. Changes made to original notes will not obliterate the original information and will be dated and signed. Standard format information sheets will be used whenever appropriate and will be retained in the permanent project files.

- Driller Logs -- The drilling contractor will maintain boring and well construction logs under the direction of the TRC field team leader.

3.0 SAMPLE MANAGEMENT AND TRACKING

TRC's field team leader will maintain records of: 1) sample shipments, 2) receipt of analytical results, 3) submittal of preliminary results for QA/QC review, 4) results of the QA/QC review, and 5) evaluation of the QC package from the laboratory. The objective is to ensure that only validated data with final approval are used in site analysis. All analytical data will be validated by the TRC QA/QC manager.

Preliminary data, clearly identified as such, may be used to prepare internal review documents, to begin data analysis, and to perform a preliminary screening of remedial action alternatives. The final site characterization report, however, will clearly identify all validated data and will be accompanied by QA/QC comments and data.

3.1 Sample Identification and Chain-of-Custody

The field team leader will coordinate sample analysis with the laboratory. TRC and the laboratory will use standard chain-of-custody procedures for sample tracking which have been approved by EPA as established under the Contract Laboratory Program (CLP) and the Navy according to Naval Energy and Environmental Support Activity (NEESA) guidance. Chain-of-custody procedures are further described in the QA/QC Plan. A TRC professional will assign a unique sample identifier to each sample in the field, and each sample will be labeled according to the proper chain-of-custody procedures. Subsequently, an environmental professional expert in laboratory QA/QC procedures will be designated as the project sample custodian, who will continue the

chain-of-custody procedures by assigning a laboratory control number to each sample. This control number, along with the number assigned in the field, accompanies the sample throughout analysis, and back to the field team leader with the analytical results. Chain-of-custody procedures are further described in the QA/QC Plan.

3.2 Reporting of Analytical Results

Laboratory data reporting procedures are provided in the NEESA-approved laboratory QA Manual, the NEESA "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration program, June 1988", and in the QA/QC Plan prepared for this project. These procedures yield analytical data and QA/QC summaries on flexible diskettes. Software format will be specified by the Engineer-in-Charge (EIC) for the NETC-Newport project. The laboratory procedures are briefly outlined below.

- Manual Recording -- EPA (CLP) Standard Operating Procedures (SOP) describe the QC procedures used for laboratory notebooks and include data worksheets which are routinely used in the reduction of quantitative instrument data to a report format expressed in terms of concentration. Instrumental data is entered on summary worksheets using microcomputers and appropriate software.
- Automated Recording -- Many analytical measurements at the laboratory are automatically recorded; e.g., complex analytical instruments (GC/MS, ICAP, AA, etc.) have their own computerized data systems. Instrument checklists include checks on the operation of these data handlers and internal validity checks are used to flag data resulting from electronic interferences.
- Calculation of Results -- Whenever possible, calculations are computerized for efficiency and to avoid human error. The analytical data systems mentioned above calculate results as programmed and provide hard copy in the desired format. In all cases, computerized data are verified for error control, and careful handling of computer storage peripherals is stressed. Tests are built into the programs to trap transcription errors or missing items. The record of the run contains the calculation results, any transcription errors or missing items, and the input data. Analytical results are reduced to the correct number of significant figures for the particular measurement technique.

- Data Review -- Acceptance limits are provided to help the operator sort questionable data and control charts are used whenever possible to show if the procedure is in control. The laboratory Quality Control Coordinator initiates control charts for instrument performance and specific analytical methods, and reviews routine and specialized QC sample results as they pertain to each project. In the laboratory, the Project Manager and the Operations Manager review data promptly to ensure its reasonableness and determine if corrective action is needed.
- Data Validation -- Data validation is the process of filtering data and accepting or rejecting it on the basis of sound criteria. Records of all data are maintained, even those judged to be "outlying" or anomalous values. The analytical data will be validated according to the "Laboratory Data Validation Functional Guidelines for Evaluating Organic/Inorganic Analyses, April, 1985" and the NEESA-approved "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program, June 1988". These documents will provide the criteria for accepting or rejecting analytical data. Analytical data will be validated (Level C) using the following general criteria:
 - Documentation of sample identity and handling (e.g., preservation, and required analyses)
 - Use of approved analytical procedures
 - Use of QC-checked reagents
 - Use of known QC samples (Laboratory Control Samples) to ensure that the analytical system was in control
 - Analysis of required blanks, duplicate and blind QC samples completed, and
 - Precision and accuracy achieved on replicate and blind QC samples.

4.0 DOCUMENT CONTROL

A document inventory and filing system will be established for this program. The system will use serially-numbered documents, organized into the categories shown in Table 1.

The TRC Project Manager will be responsible for document control. All originals will be maintained in the central file. Project staff will make copies of documents, as needed, and return the originals. The file will have the capability for locking during non-business hours.

TABLE 1

PROJECT FILE ORGANIZATION FOR NETC-NEWPORT

1.0 Remedial Response

- Initial Assessment Study report and documentation
- Confirmation Study report
- Other investigation reports
- Hazard Ranking System data (if available)

2.0 Remedial Planning

- Correspondence
- RI/FS work plan
- RI/FS reports
- Health and Safety Plan
- Quality Assurance/Quality Control Plan
- Record of Decision/responsiveness summary (as appropriate)

3.0 Remedial Implementation

- Remedial design reports
- Permits
- Contractor work plans and progress reports
- Corps or Engineers agreements, reports, and correspondence (as appropriate)

4.0 State and Other Agency Coordination

- Correspondence
- Status of State assurance
- Interagency agreements
- Memorandum of Understanding with the State of Rhode Island

5.0 Community Relations

- Interviews
 - Correspondence
 - Community Relations Plan
 - List of people to contact, e.g., local officials, civic leaders, environmental groups
 - Meeting minutes
 - Press releases
 - News Clippings
 - Fact sheets
 - Comments and responses
 - Transcripts
 - Summary of proposed plan
 - Responsiveness summary (as appropriate)
-

TABLE 1
PROJECT FILE ORGANIZATION FOR NETC-NEWPORT
(Continued)

6.0 Imagery

- Photographs
- Illustrations
- Other graphics

7.0 Contracts, Subcontracts

- Site-specific subcontractors for RI
- Procurement packages
- Subcontract status notifications
- List of subcontractors
- Project cost-accounting and management data

8.0 Financial Transactions

- Cross-reference to other financial files and the contact person(s)
 - Contractor cost reports
 - Audit reports
-

5.0 DATA MANAGEMENT

TRC will use a computer database to store and manage information to be collected and generated from the five sites to be investigated during this program. The information to be stored in the database will include: 1) historical data, 2) regulatory guidelines, 3) field data measurement results (i.e., pH, temperature, water level readings, etc.), 4) chemical analyses results, 5) the media being sampled, 6) location and depth of samples, and 7) any other pertinent information. Upon receipt of analytical results from the laboratory this data will be entered directly into the database, along with the sample number, sample location, and sample date, and any other important field information. Thereafter, all data can be easily retrieved from the database for review/manipulation.

U.S. DEPARTMENT OF NAVY
INSTALLATION RESTORATION PROGRAM

RI/FS WORK PLAN
FOR THE
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Prepared for:

Northern Division - Naval Facilities
Engineering Command
Philadelphia, PA

VOLUME V
HEALTH AND SAFETY PLAN

March 1989

TRC Project No. 5383-N81-20
Contract No. N62472-86-C-1282

NETC-NEWPORT
HEALTH AND SAFETY PLAN APPROVALS

TRC Health and Safety Director

Date

TRC On-Site Safety Coordinator

Date

TRC Project Manager

Date

Northern Division Representative

Date

NETC-NEWPORT

PERSONNEL SAFETY - CERTIFICATION AND ACKNOWLEDGEMENT FORM

All project personnel are required to make the following certification prior to conducting work at the Naval Education and Training Center, Newport, Rhode Island.

I _____ certify that:

1. I have read and fully understand the Health and Safety Plan and my individual responsibilities.
2. I agree to abide by the Health and Safety provisions in this Plan, dated March 1989.

Signature

Date

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5	TRC Accident Report Form
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7	Site 02 - Melville North Landfill - Site Work Zones
8	Site 12 - Tank Farm Four - Site Work Zones
9	Site 13 - Tank Farm Five - Site Work Zones

1.0 INTRODUCTION

This Health and Safety Plan (HASP) establishes the baseline, mandatory guidelines, and requirements for the safety of all field personnel during field investigations at the Naval Education and Training Center located in Newport, Rhode Island (NETC-Newport). The TRC Environmental Consultants, Inc. (TRC) Corporate Health and Safety Program has been developed in accordance with OSHA 29 CFR 1910.120, CERCLA 111 (c)(6), and SARA Section 126(d). The plan, therefore, provides guidelines for . . . "identifying and assessing hazards to which persons engaged in removal, remedy, and other response to hazardous substances may be exposed, (and) methods to protect workers from such hazards and . . . to ensure adequate protection and training of employees". TRC that requires all subcontractors develop Health and Safety programs for their employees prior to performing site work for TRC. Subcontractor health and safety programs must meet the same criteria presented in the TRC health and safety program.

Section 2.0 of this HASP provides a general description of the facility under investigation, and identifies the health and safety field activities to be implemented during the course of field activities. Section 3.0 discusses the TRC Corporate Health and Safety Program which is in place throughout TRC Companies. The Program addresses medical monitoring of employees as well as specialized employee training. Section 4.0 presents detailed site safety plans for each of the sites being investigated, as outlined in the Work Plan. The HASP includes the nature of wastes known to be present at each site, site access, work zones, personnel protection levels, environmental monitoring for worker protection, decontamination procedures for personnel and equipment, and contingency plans in case of a site emergency.

2.0 GENERAL PROGRAM DESCRIPTION AND FIELD ACTIVITIES

2.1 General Program Description

The NETC is located in the Town of Newport, Rhode Island. Portions of the base are also located in the Towns of Middletown and Portsmouth, Rhode Island. A significant portion of the facility is adjacent to Narragansett Bay. NETC-Newport is composed of two areas including the Coaster's Harbor Island and the Naval facility along the Narragansett Bay and the East Passage.

The presence of waste at sites within NETC-Newport were investigated during an Initial Assessment Study (IAS) in 1983. This extensive report presented all existing information on waste disposal practices at the NETC. Based on the IAS, a Confirmation Study was performed from 1984-1985. This study collected ground water, soil, and biota samples from several of the sites to confirm the presence of and initially characterize waste constituents at the sites. Together, these two studies and other investigations provide a basis for the site-specific HASP presented herein.

Five specific site areas have been identified for remedial investigation under the Navy's Assessment and Control of Installation Pollutants (NACIP) (IR) Program. The NACIP program is part of the Department of Defense Installation Restoration (IR) program, and is similar to the U.S. EPA's Superfund program authorized by The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of 1980. In March 1988, the Navy issued policy guidance which emphasized the Navy's commitment to follow EPA guidance and procedures while conducting investigations and remedial actions at hazardous waste sites.

2.2 Field Activities

This section identifies the health and safety field activities that will be followed during field investigations at NETC-Newport. The following activities are addressed in detail in the site-specific safety plan presented in Section 4.0:

- Basic operating procedures for the safety of field personnel;
- Work zones and perimeter controls at each site;
- Decontamination procedures for personnel and equipment;

- Monitoring of sampling activities for health and safety concerns;
and
- Atmospheric monitoring procedures, as deemed necessary.

3.0 CORPORATE HEALTH AND SAFETY PROGRAM

As part of TRC's Safety Policy, a comprehensive corporate health and safety program is in operation within the company. The program requires that all active field personnel undergo medical monitoring and OSHA training as outlined in the following sections.

3.1 Medical Monitoring Program

Medical monitoring is an integral part of TRC's health and safety program. The establishment and use of a medical monitoring program in conjunction with personal monitoring confirms the effectiveness of all other safety procedures. Indications of a high level of contamination at a work site, coupled with strongly positive clinical laboratory test results, may signify: an exposure to a toxic substance, a failure to observe safety procedures, improper selection of safety equipment, or a person with a hypersensitive response to certain substances.

A consulting, board-certified, occupational physician and the Company Health and Safety Coordinator will determine the protocol for the medical monitoring program for the NETC-Newport project based upon site-specific information and risk assessment histories. Clinical laboratory testing protocols will then be determined by the examining physician. The names, addresses, and telephone numbers of TRC's occupational physicians are provided below:

Howard J. Johnson, M.D.
60 Gillett Street
Hartford, CT 06101
(203) 247-4538

David E. Wilcox, M.D.
28 Main Street
East Hartford, CT 06108
(203) 569-8644

Each employee and subcontractor employee must have medical clearance prior to the commencement of any site work. Medical evaluations are conducted periodically according to the outlines specified in this section. The goals of the medical monitoring program are:

- To assess the health status of an employee prior to work;

- To evaluate and provide medical care for personnel in the event of a work-related accident or illness;
- To identify any adverse health effects resulting from hazardous work and to determine employee fitness for future work assignments.

TRC's hazardous waste site environmental consulting experience has shown that a strong medical monitoring program generates a sense of health and safety consciousness among project personnel.

3.1.1 Pre-Placement Medical Evaluation

Employees whose work assignments require their presence at a hazardous work site are required to have a baseline medical evaluation prior to commencement of hazardous work activity. The baseline medical evaluation consists of the following:

- Medical and Occupational History;
- Physical examination to include assessment of:
 - Cardiopulmonary system
 - General physical fitness
 - Skin
 - Blood-forming systems
 - Hepatic systems
 - Renal system
 - Nervous system
 - Pulmonary function test;
- Urinalysis to include:
 - Specific gravity
 - pH
 - Microscopic examination
 - Protein
 - Acetone;
- Blood analysis to include:
 - Complete blood count
 - Hemoglobin
 - Albumin, globulin, total protein
 - Total bilirubin
 - Serum glutamic oxalacetic transaminase (SGOT)
 - Lactic dehydrogenase (LDH)
 - Alkaline phosphatase
 - Calcium
 - Phosphorus
 - Uric acid
 - Creatinine

- Urea nitrogen
- Cholesterol
- Glucose
- BUN
- Creatine
- Iron
- Magnesium
- Sodium
- Potassium
- Chloride
- G-glutamyl transpeptidases
- Triglycerides.

Additional tests which are performed as part of the baseline examination include the following:

- Chest x-ray;
- Blood lead;
- Blood PCB; and
- Blood heavy metal screen.

Based upon this examination and a review of the employee's job description, the physician identifies any medical restrictions which would affect an employee's ability to safely perform his/her job. If no restrictions are imposed, the physician certifies the employee as capable of full participation in the work program. The examining physician communicates any medical restrictions to the Company Health and Safety Director who confirms the restrictions with the employee and management.

3.1.2 Medical Monitoring for Project Personnel

If an employee suspects that exposure to a toxic chemical or other hazard has occurred while performing project tasks, additional tests will be performed following the exposure period. Individuals are encouraged to discuss changes in their health status with the Company Health and Safety Director and/or physician.

Emergency health care support (i.e., fire, police, local hospital) will be notified of activities at all uncontrolled sites and at those facilities where it is deemed prudent. Telephone numbers for such support facilities are provided in Table 1 of Section 4.3.2 of this plan.

3.1.3 Follow-up Medical Evaluations

Each person who participates in hazardous work activity is required to have an annual follow-up medical examination. The follow-up medical evaluation consists of the following:

- Basic medical evaluation (previously described); and
- Additional medical testing as dictated by hazardous work history and other health status changes during the previous year.

All medical records are retained by the health care facility for a minimum of 5 years. Individuals may obtain copies of their medical records by forwarding a written request to the health care facility. A medical data sheet will be completed by all site personnel prior to all investigation activities. An example of the data sheet is provided as Figure 1. This sheet will be confidential and kept in the field trailer for reference in emergencies, as is necessary.

3.2 Employee Training Program

TRC personnel and all subcontractors assigned to hazardous field work undergo a 40-hour Occupational Safety and Health Administration (OSHA)-approved safety training program designed to:

- Ensure maximum regard for the health and safety of all employees, the public, and the environment;
- Comply with all laws, rules, and regulations required to safeguard the health and safety of all employees, the public, and the environment;
- Increase the ability of employees to react responsibly and safely under normal conditions and during emergency situations; and
- Educate personnel relative to potential site hazards, adverse chemical effects, and the importance of good safety and industrial hygiene practices.

Mandatory training programs are held annually to refresh employees' health and safety awareness. Training programs include, but are not limited to the following subjects.

3.2.1 Site Topography

- Site surveillance/observation/plan development;
- Restricted zone definition;
- Contamination reduction zone definition; and
- Clean zone definition.

3.2.2 Vehicles

- Inspection;
- Operation;
- Mandatory Rules and Regulations; and
- Decontamination.

3.2.3 Hazard Communication

- Potential Hazards;
- Waste storage;
- Transportation (DOT requirements for sample preservation);
- Labelling; and
- Material Safety Data Sheets (MSDS).

3.2.4 Personnel Protection

- Respiratory Protection
 - Selection;
 - Fit-testing;
 - Use and maintenance.
- Personnel Protective Equipment
 - Clothing;
 - Eye protection;
 - Foot protection;
 - Head protection;
 - Ear protection;
 - Equipment limitations;
 - Equipment decontamination and disposal.

- Emergency Procedures
 - Cardiopulmonary resuscitation;
 - First aid training;
 - Accident/incident reports;
 - Emergency services:
 - a. Fire;
 - b. Police;
 - c. Ambulance;
 - d. Poison control;
 - e. Hospital.
- Fire Prevention
 - Contingency plans;
 - Use of fire extinguishers.
- Standard Operating Procedures
 - Testing of work tools and equipment;
 - Sampling equipment;
 - Awareness of fellow employees;
 - Work hours;
 - Stress/fatigue;
 - Safety rules/regulations;
 - Key site personnel.

4.0 SITE-SPECIFIC HEALTH AND SAFETY PLAN

4.1 Introduction

The site-specific health and safety plans presented in this section provide detailed requirements and procedures for all field activities planned at NETC-Newport. On-site activities will include sampling of surface soils, subsurface soils (borings and test pits), tank/structure sampling, and ground water sampling of monitoring wells. These activities will be performed in a manner designed to minimize the potential for hazardous substance migration and to maximize the protection of on-site personnel. Sections 4.2 through 4.7 identify key personnel, contingency plans, and specific procedures that are common to all five sites identified for remedial investigation in the Field Sampling Plan. Section 4.8 addresses specific health and safety requirements at each site.

4.2 Project Personnel - Authorities and Responsibilities

TRC will oversee all field activities during the remedial investigation at NETC-Newport. Figure 2 presents the personnel organizational structure for the field investigations.

The organizational structure identifies the key personnel needed for the operation, establishes the chain-of-command, and specifies the responsibilities of each employee. The Field Sampling Plan has established the objectives of the site investigations and the logistics and resources required to complete the investigations. This section focuses on the organizational structure in specific relation to health and safety. The following subsections describe the responsibilities of the key site management health and safety personnel.

4.2.1 On-Site Safety Coordinator (OSC)

The OSC is responsible for implementing site operating standards and for coordinating all site safety activities. The OSC will seek guidance from the Company Health and Safety Coordinator on health and safety matters, as required. The OSC is responsible for conducting site-specific training and briefing sessions for TRC personnel and local and federal emergency response organizations prior to work on each site. The OSC will coordinate operations with local police and fire departments, medical emergency facilities, and

NETC-Newport emergency response organizations, as required. The OSC will play the lead on-site role regarding emergency response planning and preparedness. All decontamination procedures for personnel and equipment shall be monitored by the OSC. The OSC shall also monitor the handling, storage, and daily inspections of any Resource Conservation and Recovery Act (RCRA) wastes generated during field investigations.

4.2.2 Company Health and Safety Director (HSD)

The HSD will be responsible for review and approval of the HASP. The OSC will report directly to the HSD on matters addressed in this plan. The HSD will review all subcontractor Health and Safety Plans for adequacy, and may conduct field audits, as appropriate.

4.3 Emergency Response/Contingency Planning

Prior to the initiation of field work, the OSC and TRC Project Manager will implement general emergency procedures. The implementation of these procedures will include the following considerations in project planning, as well as site-specific training sessions for field team members.

- In the event of emergency, the contacts previously identified shall be notified. A list containing emergency services phone numbers shall be posted conspicuously at the site.
- Personnel on-site should use the "buddy" system (work in pairs). Buddies shall prearrange hand signals or other means of emergency communication in case of radio breakdown (see the following items).
- Visual contact should be maintained between "work pairs" on-site with teams remaining in close proximity in order to assist each other in case of emergencies.
- In emergencies, the following hand signals will be used:
 - Hand gripping throat: out of air, can't breathe.
 - Grip partner's wrist or place both hands around waist: leave area immediately, no debate!
 - Hands on top of head: need assistance.
 - Thumbs up: OK, I'm all right, I understand.
 - Thumbs down: No, negative.
- Field personnel should observe others for indications of toxic exposure, such as:
 - changes in demeanor
 - excessive salivation and pupillary response

- changes in speech
 - changes in coordination
 - paleness or other changes in skin color
 - shortness of breath or rapid breathing.
- Field personnel should immediately inform the OSC of non-visual effects of exposure, such as:
 - headaches
 - dizziness
 - nausea
 - blurred vision
 - irritation of eyes
 - cramps.
 - In the event that any member of the field crew experiences any adverse effects or symptoms of exposure while on the scene, the entire field crew shall immediately halt work and closely follow instructions provided by the site manager.
 - The discovery of any condition that suggests the existence of a situation more hazardous than anticipated will result in the evacuation of the field team. The hazard will be evaluated and the level of protection will be changed, if necessary, before work is resumed.
 - In the event that an accident occurs, the site manager will complete an Accident Report Form. The site manager will make the necessary changes to correct the situation that caused the accident.
 - All field crew members shall make use of their senses to alert themselves to potentially dangerous situations; e.g., presence of strong, irritating or nauseating odors.
 - Personnel shall practice unfamiliar operations before performing the actual procedure in the field.
 - Field crew members shall become familiar with the physical characteristics of the site, including:
 - wind direction in relation to contamination zones (wind indicators visible to all on-site personnel shall be provided to indicate possible routes of upwind escape);
 - accessibility to associates, equipment, vehicles and communication equipment;
 - exclusion zones;
 - site access; and
 - nearest water sources.

- Personnel and equipment in the contaminated area shall be kept to the minimum number required to complete the field activity.
- Procedures for leaving a contaminated area will be planned and implemented prior to going on-site in accordance with the site-specific HASP.

4.3.1 Roles of Personnel in Emergencies

The OSC or trained designee will always be at the site under investigation, or be available immediately by telephone or FM radio. The OSC or trained designee will immediately issue orders and take appropriate action to ensure efficient and expeditious handling of emergencies.

Specific roles of personnel at the site include the following:

- Site workers - use "buddy" system and follow procedures outlined in this plan. Contact OSC immediately if emergency arises.
- OSC-role described in introduction, above;
- NETC-Newport base staff - work with OSC at start of project to develop procedures for assistance from base staff in event of catastrophic emergency.
- TRC Company Health and Safety Director - work with OSC to provide home office support, as necessary.
- TRC Project Manager - ensure emergency response procedures outlined in this plan receive high priority and are effectively implemented.

4.3.2 Emergency Telephone Numbers and Routes to Hospital

The OSC is responsible for contacting and coordinating with local emergency facilities. Emergency telephone numbers will be posted in the TRC field office along with instructions for dealing with various emergency situations, such as explosions, fires, spills, or contact inquiries. Table 1 lists emergency phone numbers and directions to the local hospital. Two figures are provided which show the route to the nearest local hospital. Figures 3 and 4 together show the route from all of the sites to the nearest hospital.

TABLE 1
SITE EMERGENCY CONTACTS
(TO BE POSTED)

NETC Emergency Numbers:

Command Duty Officer (CDO)	841-3456 or 3457
Security Office	841-3241
NETC Fire Protection	841-3333
Public Works Duty Officer	841-2464 or 2465
U.S. Coast Guard - Newport	846-3675

Melville North Landfill (Site 02)

Portsmouth Police Department	683-2422
Portsmouth Fire Department	683-1155
Newport Hospital - Emergency Room Friendship Avenue, Newport	846-6400
Poison Control Center	1-277-5727

Utilities:

Electric	847-3041
Gas	846-0578
Phone	841-2422
Wastes	847-0154
NETC Dig Safe	841-4001

Additional Resources

Agency/Company

Phone Number

Dr. Howard Johnston	TRC Company Physician	(203) 247-4538
Dr. David Wilcox	TRC Company Physician	(203) 569-8644
James Peronto	TRC Project Manager	(203) 289-8631
Rachel Marino	NETC Contact	(401) 841-3735
Robert Hanley	NETC Safety Officer	(401) 841-2478

Route to Hospital (also see Figures 3 and 4):

After proceeding through Gate 1, proceed east on Training Station Road to Malboro Road. Proceed 11 blocks to Broadway: Head South on Broadway, turn east on Friendship Avenue. Emergency Room entrance is the first left.

4.3.3 First Aid Training

All members of TRC's field investigation staff have received Red Cross first aid training and are trained in CPR. First aid will only be administered by trained individuals.

Site-specific first aid training will include the following:

- General procedures;
- Location and use of first aid station, hospital, doctor, and ambulance services;
- Procedures for accident reporting;
- No movement of injured persons unless immediate danger is present;
- Immediate treatment procedures for burns, scratches, cuts.

4.3.4 Emergency Response to Specific Emergencies

Physical Injury

Physical injuries can range from a sprained ankle to a compound fracture, from a minor cut to massive bleeding. Depending on the seriousness of the injury, treatment may be given at the site by trained response personnel. For more serious injuries, additional on-site assistance may be required or the victim may have to be treated at a medical facility.

Life-saving care should be administered immediately without considering decontamination procedures. The outside garments can be removed (depending on the weather) if they do not cause delays, interfere with treatment, or aggravate the problem. Respirator assemblies must always be removed, unless serious neck injuries are suspected. Chemical-resistant clothing can usually be cut away. If the outer contaminated garments cannot be safely removed, the individual shall be wrapped in plastic sheeting, or blankets, to help prevent contaminating medical personnel and the interiors of ambulances. Outside garments can then be removed at the medical facility. No attempt will be made to wash or rinse the victim at the site. One exception would be if it is known that the individual has been contaminated with an extremely toxic or corrosive material which could also cause severe injury or death. Another exception would be the flushing of eyes with water when harmful substances

have accidentally enter the eye. For minor medial problems or injuries, the normal decontamination procedure shall be followed.

Heat Stress

Heat-related illnesses range from mild heat fatigue to heat stroke (which is the most serious form of heat stress). Heat stroke requires prompt treatment to prevent irreversible damage or death. Unless the victim is heavily contaminated, decontamination should be omitted or minimized and treatment begun immediately. Protective clothing may have to be cut away. Less serious forms of heat stress require prompt attention or the victim may lapse into heat stroke. Appendix A summarizes various heat stress symptoms and describes the preventative and first aid methods.

Cold Stress

Cold-related illnesses range from frost bite to hypothermia. Methods of symptom recognition, preventative measures and first aid methods are included in Appendix A.

Chemical Exposure

Exposure to chemicals can be divided into two categories:

- Injuries from direct contact, such as acid burns or inhalation of toxic chemicals; and
- Potential injury due to gross contamination on clothing or equipment.

For inhaled contaminants, treatment shall only be administered by qualified physicians. If the contaminant is on the skin or in the eyes, immediate measures shall be taken to counteract the substance's effect. First aid treatment generally consists of flooding the affected area with water for an extended period of time.

When protective clothing has become grossly contaminated, contaminants may be transferred to first aid personnel or the wearer and cause additional injuries. Appropriate precautions will be taken to protect emergency medical personnel from harmful contaminants.

A TRC Accident Report will be completed for all accidents which occur during the investigation. An example of a TRC Accident Report is provided as Figure 5.

4.3.5 Emergency Decontamination

Appendix B provides site-specific chemical hazard information in the form of Material Safety Data Sheets (MSDs) for chemicals known to be present or used at the sites being investigated. Emergency decontamination procedures include the following:

- Another team member (buddy) will remove the individual from the contaminated area.
- Precautions will be taken to avoid exposure of other individuals to the contaminants.
- If contaminants are on the individual's clothing, the clothing shall be removed, if it is safe to do so.
- If contaminants have contacted the skin, the skin should be washed with copious amounts of water, preferably under a shower.
- In case of eye contact, an emergency eye wash apparatus shall be used. Eyes should be washed for at least 15 minutes.
- If necessary, the victim will be transported to the nearest hospital or medical center. If necessary, an ambulance will be called to transport the victim.
- All chemical exposure incidents will be reported in writing by the site manager on an Accident Report Form.

Under certain circumstances, decontamination efforts may aggravate or cause more serious health effects. If prompt life-saving first aid and medical treatment is required, decontamination procedures will be omitted. In such a case, the procedures for omitting decontamination, outlined in Section 4.3.6 of this plan, should be followed. Whenever possible, TRC personnel shall accompany contaminated victims to the medical facility to advise medical personnel on matters involving decontamination.

When protective clothing is grossly contaminated, contaminants may be transferred to treatment personnel (or the wearer) and cause injuries. Therefore, unless severe medical problems have occurred simultaneously with

the splashes, the protective clothing should be washed off as rapidly as possible and then carefully removed.

4.3.6 Site Work Zones

Each site will be divided into designated work zones to control and reduce both the possibility of human contact with site contaminants and the removal of contaminants by personnel or equipment leaving the site. Overall site control is necessary to provide safe working conditions for on-site personnel. Each site will be divided into four contiguous zones: 1) a support area which will be considered noncontaminated or "clean", 2) a personnel decontamination area, 3) a heavy equipment decontamination area (at three of the sites), and 4) an exclusion area which will be considered contaminated. The location of each of these zones on the five sites is described in Section 4.8 of this plan.

The support zone will contain the investigation support equipment (i.e., command post, equipment storage area, vehicles). The field office trailer, which will be located in the support zone for the McAllister Point Landfill site, will be the central command center for all five site investigations. All of the other site support zones will contain the on-site personnel vehicles, which will provide daily storage space and temporary shelter for the personnel.

The decontamination zone will be marked and consist of an area between the exclusion zone and support zone. All personnel and equipment entering or exiting the exclusion zone will pass through a contamination reduction zone, except in the case of an emergency when it may be necessary to use an alternate exit. All personnel entering the exclusion zone will wear prescribed protective equipment. All personnel exiting the exclusion zone are required to pass through the decontamination zone and follow appropriate decontamination procedures.

The heavy equipment decontamination zone will be constructed as described in the Field Sampling Plan provided in Volume II of this Work Plan. All personnel entering this area will be required to wear the prescribed personal protective clothing. Upon exiting this area, all personnel are required to pass through the personal decontamination zone prior to entering the support zone.

The exclusion zone at four of the sites (Sites 01, 02, 12 and 13) is defined by the site boundary and land access is restricted to these sites by a fence. Given the open public access to the remaining site (Site 09), the exclusion zone at this site will be defined at each major site activity with barricades and flagging tape.

4.3.7 Site Security

All five sites are located within NETC-Newport. Tank Farms Four and Five are surrounded by tall chain-link fences with locking gates. The McAllister Point Landfill and the Melville North Landfill are partially fenced with locking gates. Access to these four sites is through the locked gates and from Narragansett Bay at the two landfill sites. The fifth site, the Old Fire Fighting Training Area, has no existing fence to limit public access. Portions of the site are currently used as a public park and by a child day-care center. During the investigation activities at this site, public access will be restricted from major activity areas (e.g., borehole drilling and well installation) with barricades and "RESTRICTED AREA" flagging tape. Perimeter control of all sites under active investigation will be established through the use of either "RESTRICTED AREA" flagging tape or signs. A Site Access Logbook will be kept at each support zone during the field investigation activities. The logbook will contain a record of all site investigation personnel and site visitors.

NETC-Newport base security personnel will be regularly kept advised of project status, and requested to monitor restricted areas, as required.

4.4 Standard Operating Procedures

4.4.1 General

The On-Site Safety Coordinator will ensure that standard operating procedures are followed, as listed in the EPA manual entitled: "Standard Operating Safety Guides." These procedures have also been stressed in the development of this health and safety plan.

The following safety rules will be in effect for all hazardous field activity:

- No smoking, eating, drinking or gum chewing on-site.

- No open fires or "hot work" (welding) without express written approval of the On-Site Safety Coordinator.
- All specified personal protective equipment must be worn at all times.
- All personnel entering a site must be accompanied by another individual and have the authorization of the On-Site Safety Coordinator.
- Avoid contact with potentially contaminated substances.
- Avoid walking through puddles, pools or mud.
- Do not kneel or sit on the ground.
- Do not lean against equipment, drums, or other potentially contaminated items.
- Avoid passing through any "hot areas".
- Report all accidents, injuries, or possible exposures to the OSC immediately.

The On-Site Safety Coordinator will report any chemical release to the Project Manager and the U.S. Navy site representative. The On-Site Safety coordinator will report any personnel exposure resulting from a chemical release or equipment failure immediately to the Company Health and Safety Director.

All site operations will be conducted in accordance with the applicable state and Federal regulations and recommended procedures. Guidelines and procedures as described in the following references are utilized for all hazardous field operations.

1. Pocket Guide to Chemical Hazards--The On-Site Safety Coordinator will utilize this information to establish the necessary levels of personal protection needed on-site. The guide tests exposure limits for chemical species, the appropriate protective equipment, and the health hazards associated with accidental exposure.
2. The Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities--This publication provides guidance for preparing site-specific health and safety plans. The publication includes planning and organization of site operations, incorporating the health and safety plan into the overall site operations plan, appropriate training topics, and techniques for characterizing site hazards. This publication was used to prepare site-specific plans in this document.

4.4.2 Material Handling Safety and Heavy Equipment Operation

The following guidelines will be applicable to work involving material handling and heavy equipment. Prior to performing work of this nature, a review of these principles shall be given to workers by the OSC:

- Pay attention at all times.
- Use common sense.
- Hard hats shall be worn on-site at all times.
- When noise makes verbal communication difficult, hand signals should be used. One person shall be responsible for hand signals given to heavy equipment operators.
- When lifting objects, use the legs, not the back.
- Use appropriate equipment to move heavy objects.
- Only qualified operators shall operate heavy equipment.
- Maintain visual contact at all times.
- Be aware of footing at all times.
- Never walk in the vicinity of heavy equipment without the operator being aware of your presence.
- Be aware of all nearby underground or overhead power lines, gas lines, etc., when operating heavy equipment.
- Make sure that gas cylinders are secured to heavy equipment.

4.4.3 Subcontractors

All subcontractors participating in hazardous field activity will adhere to a Health and Safety Plan approved by the TRC Company Health and Safety Director. Compliance with the provisions of both the TRC and subcontractor health and safety plans will be monitored by the TRC On-Site Safety Coordinator.

4.4.4 Field Office and Sanitary Facility

A site field office (mobile construction trailer) will be established at the McAllister Point Landfill site. This trailer will be designated a "clean" area where only authorized personnel are allowed. A portable personnel sanitary facility will be located near the field trailer. The sanitary

facility vendor will provide weekly servicing throughout the course of the field investigation.

Specific areas for eating will be identified and established prior to the investigations. These area(s) will be physically located away from equipment storage/preparation areas, and sample handling/storage areas. The eating area will be isolated such that field team members do not pass through equipment/sample storage areas prior to entering the eating area.

4.5 Decontamination Procedures

The decontamination of personnel, portable equipment, downhole drilling tools, and sampling equipment will take place in designated decontamination areas. Personnel working in the exclusion zone, i.e., those areas where Level D, C or B protection is worn, will undergo decontamination in the personnel decontamination area. The exterior of all sample bottles containing samples from the exclusion zone will be wiped with a damp cloth in this area.

Heavy equipment will be decontaminated in heavy equipment decontamination areas designated for each site (see Section 4.8 of this plan). Split spoon samplers will be decontaminated after each use in the immediate vicinity of the drill rig. Smaller sampling equipment (e.g., stainless steel spoons, spatulas) will be laboratory-cleaned prior to transportation to the site.

4.5.1 Specific Decontamination Procedures

The following procedures shall be used for both personnel and equipment decontamination.

Personnel (Levels D through B)

Step 1 - Sample Drop

Step 2 - Boot and Glove Wash, Rinse, Tape Removal:

- Wash with non-foaming detergent;
- Rinse with fresh water spray; and
- Second rinse with fresh water spray

Step 3 - Outer Glove Removal

Step 4 - Hard Hat Removal, Goggle Removal

Step 5 - Respirator/SCBA Wash and Rinse and Drop - Same as Step 2, wash and rinse using soft-bristle brush and sponge

Step 6 - Tyvek Suit and Boot Removal

Step 7 - Inner Glove Removal.

Contaminated clothing will be disposed of in properly labeled containers.

Split Spoon and Sampling Equipment

All drilling equipment (e.g., augers, rods) must be steam-cleaned before use and between boreholes. Split spoon samplers should be made of stainless steel, but carbon steel is acceptable if it is rust-free. Sampling equipment such as split spoons, stainless steel or spatulas, and stainless steel spoons mixing bowls shall be decontaminated using the following procedures:

Step 1 - Wash and scrub with low phosphate detergent in tap water

Step 2 - Rinse with tap water

Step 3 - Rinse with 10 percent nitric acid (1 percent nitric acid on carbon steel split spoons)

Step 4 - Rinse with distilled water

Step 5 - Rinse with hexane and methanol - pesticide grade solvents or better

Step 6 - Rinse with distilled water

Step 7 - Air dry - on clean polyethylene sheeting

Step 8 - Wrap in aluminum foil, "shiny" side out for transport (unless used immediately).

Clean equipment may rest on--but never be wrapped--in clean polyethylene sheeting.

Heavy Equipment (Drill Rigs, Backhoe, Downhole Tools, Casing Materials, and Other Drilling Tools)

Separate areas identified in the Field Sampling Plan will be designated for the decontamination of heavy equipment. There will be one such area designated at both landfills and Tank Farm Five. A steam cleaner will be used to decontaminate the under-carriage, wheels, track, and drill derrick between each boring. A shallow pit will be excavated and lined with two 10 to 12 mil thick, nylon reinforced polyethylene plastic tarps where these vehicles will be parked during decontamination operations.

In order to minimize the spreading potentially contaminated soil, removal of gross contamination from downhole tools and drill rig will occur at the individual sites prior to transportation to the decontamination pit. This will involve on-site removal of loose soil from the tools and rig, and containerization tools in the back of a truck while transporting them to the decontamination pit.

Monitoring Well Materials

All monitoring well materials (screens and riser sections) will be decontaminated prior to installation. The decontamination procedures will be conducted with a steam cleaner in the designated areas described above.

Decontamination Equipment Checklist

- Plastic garbage barrels;
- Liners for garbage barrels;
- Galvanized steel basins;
- "Alconox" detergent concentrate;
- Hand pump sprayers;
- Long-handled soft bristle brushes;
- Large sponges;
- Antiseptic respirator cleanser;
- Small stools or step ladders;
- Plastic bags;
- Acetone;
- Steam cleaner;
- Liquid detergent and paper towels;
- Glycol (antifreeze); and
- Benches

4.5.2 Disposal Methods - Decontamination Equipment and Rinses

All waste material (i.e., contaminated disposable protective clothing) and rinse solutions resulting from decontamination activities will be placed in DOT-approved 55-gallon drums. Drums will be handled, stored, and disposed by a licensed waste hauler in accordance with state and federal regulations under the Resource Conservation and Recovery Act (RCRA). Additional drum handling and storage details appear below.

4.5.3 Drum Handling and Storage

The general procedures recommended in EPA's Compendium of Superfund Field Operations Methods (EPA, 1987) for the control of field work-generated contaminated material will be incorporated into the waste and drum handling plan. All applicable RCRA and Rhode Island Department of Environmental

Management (RIDEM) regulations will be followed for all wastes generated through investigative activities. The applicable federal regulations are stated in 40 CFR 262 entitled "Standards Applicable to Generators of Hazardous Waste".

4.5.3.1 General Procedures for Waste Disposal

Provided below is an outline of the suggested procedures for the disposal of investigation-derived wastes:

1. Obtain RCRA EPA Notification of Hazardous Waste Activity Form (Form No. 8700-12).
2. Obtain a RCRA generator provisional number from the EPA.
3. Fill out the provisional number questionnaire and submit it to the EPA.
4. Contact waste transporters and disposers to request bids for their services; obtain necessary documentation required by vendors for those services. (All companies require the filing of some type of waste data sheet.) A bid will not be awarded until a waste characterization, including data, is provided to the transporter/disposer.
5. Obtain necessary state/federal shipping and disposal manifest forms. (A manifest is required from the state where the waste originated.)
6. Conduct field activities.
7. Sample and characterize waste. This step includes all RCRA parameters plus all special analyses (e.g., PCBs, oil/grease). (TRC anticipates that all generated waste will be hazardous.)
8. Receive sample analyses results from laboratory.
9. Complete waste data sheets and submit them to potential transporters and disposal facilities.
10. Receive bids for transportation and disposal activities.
11. Prepare EPA Form 8700-12, including waste characterization data for sign-off by designated Navy official. (Note: Waste materials generated will be considered Naval property, and a Naval official must sign all required forms.)
12. Prepare state and Federal shipping and disposal manifest forms for signature by Navy personnel.
13. Award subcontract for waste transportation and disposal.

4.5.3.2 Waste Pre-Transport Requirements

Hazardous waste pre-transport requirements stated in 40 CFR 262 Subpart C will be followed throughout the investigation. Drums will be packaged in accordance with DOT regulations under 49 CFR Parts 173, 178 and 179. Each drum will be labeled and marked in accordance with DOT regulations on hazardous materials under 49 CFR Part 172. The drums will clearly display the generator's name and address, manifest document number, and the designation "Hazardous Waste."

4.5.3.3 Drum Storage

TRC intends to store drums on behalf of the Navy at the designated site drum staging areas for less than 90 days (extensions possible). This will avoid storage facility requirements of 40 CFR Parts 264 and 265 as well as permit requirements of 40 CFR 270. (Note: Exception for waste accumulation not exceeding one drum in 40 CFR 262.34(c)(1).)

Drums will be stored in a designated drum staging areas on site numbers 01, 02, and 13. Spill containment at each drum staging area will be obtained by storing the drums as follows:

- Entire drum staging area will be isolated from other areas by snow-fencing;
- Storage on 4-mil thick plastic barrier underlain by adsorbent material (such as "Speedi-dry");
- Storage area perimeter shall contain absorbent material arranged in a temporary berm approximately 6 inches high;
- Perimeter berms covered by plastic, weighted down by rocks, bricks, heavy lumber, or other suitable materials; and
- Storage area will be covered entirely by a 4-mil thick plastic sheet and weighted to ground, outside perimeter of the berm.

The contingency plan for monitoring of potential spills include the following:

- Maintain integrity of snow fence;
- Drum storage area will be inspected daily for spills or leaks by the On-Site Coordinator for Health and Safety or trained designee during TRC field activities; and

- Drum storage area will be inspected monthly during periods when TRC is not on-site performing field studies.

The following procedures will be followed if periodic inspections reveal a leaking drum.

- Provide personnel protective clothing, respirators, and organic vapor monitoring as specified in this plan;
- Apply absorbent material to spilled liquids as necessary to collected free liquids;
- Placed saturated absorbent in properly labeled 55-gallon drums;
- Inspect 4-mil plastic barrier for evidence of breaching. Lift barrier and check absorbent material sub-layer with OVA or HNU. Remove any contaminated material and place in labeled 55-gallon drums.

4.5.3.4 Recordkeeping and Reporting

On behalf of the Navy, TRC will follow recordkeeping and reporting requirements under 40 CFR 262 Subpart D. In the event that TRC's contract with the Navy expires, the recordkeeping responsibilities will revert back to the U.S. Navy.

4.6 Levels of Personnel Protection/Environmental Monitoring

The following concentrations for total organic vapors (measured with an OVA or HNU) and percent oxygen (measured with a portable oxygen monitor) will be used to establish the required level of personnel protection within the exclusion zone, upon initial site entry:

Known waste - no air hazard	Level D
0-5 ppm above background	Level C
5-500 ppm above background	Level B
Less than 19.5% oxygen	Level B
500-1000 ppm above background	Level A

4.6.1 Levels of Protection

The personnel protective equipment required for each protection level is as follows:

Level D

- Hard hat
- Chemically-resistant, steel-toe and shank boots
- Tyvek coveralls (or equivalent) (coated for aqueous sampling)
- Inner gloves (vinyl)
- Outer gloves (neoprene)
- Safety goggles (only for aqueous sampling).

Level C

- Hard hat
- Chemically-resistant steel-toe and shank boots
- Disposable tyvek coveralls with hood (or equivalent) (coated for aqueous sampling)
- Inner and outer gloves (vinyl and neoprene, respectively)
- Full-face respirator with organic vapor cartridges and dust mist, fume pre-filter.

Level B

Level C protection, except that the full-face respirator will be replaced with positive pressure type self-contained breathing apparatus (SCBA).

4.6.2 Environmental Monitoring

A specifically designated TRC employee will be assigned the task of continuously monitoring for organic vapor emissions during the drilling and test pitting, and tank/structure sampling operations performed at the sites. A combustible gas (lower explosive limit (LEL)) and oxygen (O₂) alarm meter will also be used to continuously monitor levels of combustible gas and oxygen during these activities. An OVA, or HNu will be used during all field sampling activities. The OVA and/or HNu will be calibrated once per day using hydrocarbon-free "zero" air and air containing a known hydrocarbon concentration. The OVA and HNu calibration gases consist of concentrations of 10 ppm methane in air and 100 ppm isobutylene in air, respectively. The LEL/O₂ meter will be calibrated once per day using pentane (0.75 percent by volume in air). All instrument calibration notes and readings will be recorded in the respective instrument log maintained at the site support zone or command center equipment files. All instrument readings observed during

site monitoring/sampling activities will be recorded in a field notebook. Calibration procedures for the instruments are provided in Volume III - QA/QC Plan of this Work Plan.

If airborne concentrations of flammable vapors exceed 10 percent of the LEL at the point of drilling, no ignition sources will be permitted in the area. If the airborne flammable concentration reaches 25 percent of the LEL at a distance of 1 foot, or 10 percent at a distance greater than 2 feet from the point of drilling, then excavation operations will be suspended, and corrective action taken (backfilling of the borehole or excavation).

If changes in ambient concentrations are detected, the Site Manager and/or the OSC Officer may require a change in the personnel protection level. Personnel shall change protection levels (e.g., change from respirator to SCBA) in the partial decontamination area established in the Decontamination Zone and then reenter the Exclusion Zone. This procedure precludes the necessity of performing complete decontamination when changing protection levels. The refilling of SCBA air tanks will occur in the Decontamination Zone using a cascade air system. Personnel responsible for refilling air tanks will be required to use appropriate personnel protective clothing as directed by OSC.

4.7 Site Documentation

Documentation and implementation of the provisions of this HASP will be recorded in the master log book and placed in the site file. The file shall contain the following health and safety information:

- Records of calibration of environmental monitoring equipment;
- Signed copies of the Personnel Safety Certification and Acknowledgement Form (see front pages of this plan); and
- Copies of all TRC Accident Reports.

4.8 Site-Specific Health and Safety Requirements

The site-specific information presented below was obtained from previous site investigation reports and other sources. All appropriate references for the information are provided in the Background Investigation Report contained in Volume I of this Work Plan.

4.8.1 Site 01 - McAllister Point Landfill

4.8.1.1 Nature of Wastes

This landfill received all of the wastes generated at the Newport Naval complex from 1955 through the mid-1970s, and may contain at least 200 gallons of PCB-contaminated transformer oil. The landfill reportedly also contains spent acids, waste paints, solvents, and waste oils.

Records of landfill operations from 1955 to 1965 indicated that it was common practice for barrels filled with liquids to be brought to the landfill. These barrels contained paints, oils and other unidentifiable liquids. The barrels were reportedly crushed before being covered. At least two transformers, each containing approximately 100 gallons of PCB-contaminated oil, and at least 4 or 5 capacitors are also suspected of being disposed of in the landfill.

In 1965, an incinerator was built at the landfill. From 1965 through 1970-71, some 98 percent of all the wastes were burned before being disposed of in the landfill. The incinerator was shutdown and demolished sometime during 1970 due to air pollution problems. During the remaining years that the site was operational, all wastes were disposed of directly into the landfill.

Operations at the site were discontinued in the mid-1970s. A final covering of soil approximately three feet thick was placed over the landfill following its closure.

An Initial Assessment Study and Confirmation Study were performed from 1983 to 1985 at this site. The results of the studies indicate that the following contamination exists at the site: elevated concentrations of metals in the ground water; elevated concentrations of organic and inorganic compounds in leachate from the landfill; elevated concentrations of metals, petroleum hydrocarbons, and PCBs in the adjacent bay sediments; and elevated concentrations of metals in the adjacent bay mussels. Although one composite surface soil sample was collected from the site, and low concentrations of contaminants (metals) were detected in the sample, it appears as though the sample was collected from the landfill cap material which is most likely

constructed of clean fill. Given the nature of the wastes disposed of at this landfill, it is very likely that extensive soil and fill contamination exists at this site.

4.8.1.2 Site Access/Work Zones

This site will be divided into four designated contiguous work zones: 1) a support zone, 2) a personal decontamination zone, 3) a heavy equipment decontamination zone, and 4) an exclusion zone. The support zone will consist of the command center for all of the NETC-Newport site field investigations. Personnel entering this zone from the exclusion zone and/or the heavy equipment decontamination zone, must first pass through the personnel decontamination zone. Access to the exclusion zone will be restricted to first passing through the decontamination zone and then donning appropriate personal protective equipment. The area surrounding activities within the exclusion zone (i.e., boreholes or test pitting) will be marked with flagging. The locations of the site work zones are shown on Figure 6. The On-Site Safety Coordinator (OSC) will be responsible for oversight of personnel and equipment decontamination, and site access control.

4.8.1.3 Personnel Protection

This site is partially covered with vegetation, and includes areas of exposed waste deposits which may increase the risk of exposure to on-site personnel. Individuals involved in activities in the decontamination reduction zone will be required to use Level D personnel protection. Based on preliminary site observations, it appears that Level D protection will be sufficient for personnel involved in surface soil, surface water and ground water sampling activities on this site. Level C protection will be available for use during these activities if necessary, as indicated by continuous air monitoring results and/or directions of the OSC. Due to the nature of the chemical hazards present on the site, Level C personnel protection will be used by personnel involved in drilling activities. Level B personnel will be available for use during these activities, if necessary, as indicated by air monitoring results and/or by the OSC. Additional eye and ear protection will be available, including: splash guard and, in the event of excessive noise, earplugs.

(SEE TABLE 2 FOR PERSONNEL PROTECTION SUMMARY)

TABLE 2
PERSONNEL PROTECTION SUMMARY

Site	Activity	Level of Protection ⁽¹⁾
McAllister Point Landfill	- Site Surveys	D
	- Surface Soil Sampling	D
	- Test and Well Borings	C
	- Ground Water Sampling	D
	- Surface Water, Sediment, and Biota Sampling	D
Melville North Landfill	- Site Surveys	D
	- Surface Soil Sampling	D
	- Test Pit Sampling	B
	- Test and Well Boring Sampling	C
	- Ground Water Sampling	D
Old Fire Fighting Training Area	- Surface Water, Sediment, and Biota Sampling	D
	- Site Surveys	D
	- Surface Soil Sampling	D
	- Test and Well Boring Sampling	D
	- Ground Water Sampling	D
Tank Farms Four & Five	- Surface Water, Sediment, and Biota Sampling	D
	- Site Surveys	D
	- Surface Soil Sampling	D
	- Well Boring Sampling	D
	- Ground Water Sampling	D
	- Surface Water and Sediment Sampling	D
	- Tanks and Structure Sampling	B/C ⁽²⁾

(1) These are the anticipated initial levels of personnel protection for each site investigation activity. These levels will either be upgraded or downgraded as conditions dictate according to criteria defined in Section 4.6 of this plan.

(2) Level B will be used for confined space sampling activities and Level C will be used for open space sampling activities.

4.8.2 Site 02 - Melville North Landfill

4.8.2.1 Nature of Wastes

This site was used as a landfill from World War II to 1955. Wastes reportedly disposed of in this landfill include mostly domestic type refuse and also spent acids, waste paints, solvents, waste oils (diesel, fuel and lube), and PCB containing oils. An Initial Assessment of Study (IAS) of the site indicated that wastes disposed of in this landfill would have been similar to those discussed for the McAllister Point Landfill. There is visual evidence that oil-soaked material was disposed of on one section of the site.

An Initial Assessment Study and Confirmation Study were performed from 1983 to 1985 at this site. The results of the studies indicate that oil-soaked deposits on the site contain elevated concentrations of petroleum-based hydrocarbons (32,508 ppm) and lead (60 ppm). Background concentration of metals and PCBs were detected in sediment and mussel samples collected from the bay adjacent to the site. It is important to note that the scope of these studies was very limited in that the soil sampling was limited to a small portion of the site, and no soil samples (only waste deposit samples) were collected for laboratory analyses. Given the nature of wastes reportedly disposed of at this landfill, it is very likely that extensive soil and fill contamination exists at this site.

4.8.2.2 Site Access/Work Zones

This site will be divided into four designated work zones. The support zone will consist of the command post, equipment storage and vehicle parking areas. A personnel decontamination area will be established between the site exclusion zone and the support zone. A heavy equipment decontamination zone will be established outside of the exclusion zone and constructed according to the specifications given in the Field Sampling Plan provided in Volume III of this Work Plan. The locations of the site work zones are shown on Figure 7.

4.8.2.3 Personnel Protection

Based on the results of the Confirmation Study and the past use of the site, the possibility of PCB, solvent, heavy metal and petroleum hydrocarbon contamination exists at this site. Therefore, Level B personnel protection will be required in the exclusion zone during test pitting activities.

Level C protection with Level B contingency will be required during borehole activities. Additional hearing protection will be available for personnel involved in drilling and test pitting activities. Level D protection will be required for all personnel performing surface soil, surface water, and ground water sampling activities. Use of Level D protection will also be required of personnel working in the decontamination reduction zone.

(SEE TABLE 2 FOR PERSONNEL PROTECTION SUMMARY)

4.8.3 Site 09 - Old Fire Fighting Training Area

4.8.3.1 Nature of Wastes

This site was used from World War II to 1972 as a fire fighting training area. Waste oils were combusted in various manners across the site to train personnel in fire fighting techniques. There are no records indicating the types and quantities of oil used at this site. Any oil that had been stored at the site has since been removed.

This site was not included in the May 1986 Confirmation Study. Thus there is no analytical data for an assessment of the chemical contamination at the site; however, during a 1988 geotechnical investigation at the site, oil was encountered approximately five feet below the ground surface in two borings. Given the past operating history of the site and the findings of the geotechnical investigation it is likely that subsurface contamination is present across the site.

4.8.3.2 Site Access/Work Zones

This site will not have a permanent support zone, exclusion zone or personnel decontamination zone. Since this site is now used as a public park, only the immediate area surrounding the drilling rig will be divided into work zones. Due to the ease of public access, a heavy equipment decontamination zone will not be established on this site. Heavy equipment used at this site will be decontaminated in the heavy equipment decontamination zone located at Site 12. The On-Site Safety Coordinator will be responsible for oversight of decontamination and site access control.

4.8.3 Personnel Protection

Level D personnel protection will be required for personnel working within the decontamination reduction zone and by personnel performing the surface

soil, surface water and ground water sampling activities. Level D protection will also be required for personnel involved in drilling activities with Level C equipment available as conditions dictate. Additional hearing protection will be available for personnel involved in drilling activities.

(SEE TABLE 2 FOR PERSONNEL PROTECTION SUMMARY)

4.8.4 Site 12 - Tank Farm Four

4.8.4.1 Nature of Wastes

This site consists of twelve 60,000-barrel capacity concrete underground storage tanks. These tanks were used by the Navy from World War II to the mid-1970s to store diesel and fuel oil. Two of the tanks were later used to store waste oils. The use of these tanks was discontinued several years ago, and at that time they were emptied (but not cleaned) and refilled with water.

During the operation of the tank farm, bottom sludge was periodically removed from the tanks and disposed of by burning it directly on the ground in the vicinity of the tank being cleaned. Between 100,000 and 190,000 gallons of oil sludge was disposed of at this site. The exact locations of the sludge disposal/burning areas are not known.

An Initial Assessment Study and Confirmation Study were performed from 1983 to 1985 at this site. The results of the studies indicate that the following contamination exists at this site: elevated concentrations of lead and petroleum-based hydrocarbons (PBHCs) in the ground water; elevated concentrations of PBHCs in the sediments and surface water of a swale near the brook passing through the site; elevated concentrations of lead and oil/grease in near-surface soils; and concentration of PBHCs in the contents of several of the on-site tanks. Given the site operating history of contamination documented in previous investigations, it is likely that contamination exists across the site.

4.8.4.2 Site Access/Work Zones

Three work zones will be established on this site, including a support zone, personnel decontamination zone, and an exclusion zone. Figure 8 shows the locations of the site work zones. The decontamination of heavy equipment will occur at the designated area on site 13. The On-Site Safety Coordinator

will be responsible for the oversight of decontamination activities and site access control.

4.8.4.3 Personnel Protection

Soil and surface water at this site were found to contain oil and grease, along with petroleum hydrocarbons. Level D personal protection should be sufficient for site activities including sampling of soils, surface water, and ground water. Level D protection should also be sufficient for personnel involved in the drilling activities. Level C protection will be used during drilling, if necessary, as indicated by continuous air monitoring results and the OSC. Additional hearing protection will be available for personnel involved in drilling operations. Level B personnel protection will initially be used for any confined space tank/structure sampling; however, downgrade to Level C protection will occur as indicated by continuous air monitoring results. Level C protection will initially be used for open area tank/structure sampling with the option to upgrade to Level B protection or downgrade to Level D protection, as conditions dictate.

(SEE TABLE 2 FOR PERSONNEL PROTECTION SUMMARY)

4.8.5 Site 13 - Tank Farm Five

4.8.5.1 Nature of Wastes

This site was used for the storage of diesel and fuel oil and consists of eleven 60,000 barrel capacity underground storage tanks. The site was used from World War II until the mid-1970s. Tank bottom sludge was collected during cleaning operations and disposed of in an on-site burn pit.

A Confirmation Study was not conducted at this site; however, a tank closure investigation was conducted on a portion of this site. The results of the tank closure investigation indicate the presence of elevated concentrations of metals and volatile organic compounds in the ground water and elevated concentrations of metals and organic compounds in the tank contents. Soil samples were not collected for analyses from the site; however, oily soil was observed in well borings completed during the tank closure investigation. Given the site operating history and the contamination documented in the tank closure investigation, it is likely that contamination exists across the site.

4.8.5.2 Site Access/Work Zones

The site will be divided into four work zones; including a support zone, a heavy equipment decontamination zone, a personnel decontamination zone, and an exclusion zone. The locations of the site work zones are shown on Figure 9. The heavy equipment decontamination area on this site will be used for the decontamination of heavy equipment from sites 09 and 12. The On-Site Safety Coordinator (OSC) will be responsible for the oversight of decontamination activities and site access control.

4.8.5.3 Personnel Protection

The exposure hazard at this site consists of petroleum hydrocarbons and PCBs. Level D personal protective equipment should be sufficient for site activities including the sampling of surface soils, surface water and ground water. If necessary, Level C personal protective equipment will be used during drilling activities, as indicated by continuous air monitoring results and/or the OSC. Additional eye and ear protection may be required during drilling operations as deemed necessary by the OSC. Level B personnel protection will initially be used for any confined space tank/structure sampling; however, downgrade to Level C protection will occur as indicated by continuous air monitoring results. Level C protection will initially be used for open area tank/structure sampling with the option to upgrade to Level B protection or downgrade to Level D protection, as conditions dictate.

(SEE TABLE 2 FOR PERSONNEL PROTECTION SUMMARY)

APPENDIX A
HEAT AND COLD STRESS
SUMMARY OF PREVENTIVE AND FIRST AID PROCEDURES

Heat Exhaustion

Heat exhaustion is brought about by the concentration of blood in the vessels of the skin. This condition may lead to an inadequate return of blood to the heart and, eventually, to physical collapse. The symptoms are:

- General weakness
- Excessive perspiration
- Dizziness
- Appearance of having fainted
- Pale and clammy skin
- Weak pulse
- Rapid and shallow breathing

To treat for heat exhaustion, place the individual in a cool place and remove as much clothing as possible. The individual should drink cool water, "Gatorade" or other similar liquid. The individual should be fanned, however, do not over-cool or allow chilling. Treat the individual for shock and remove to medical facility if condition persists.

Heat Cramps

Heat cramps are usually caused by loss of salt when an individual has perspired a great deal. Cramps in the leg and abdominal muscles can also be caused by rapidly drinking iced liquids, or in large quantities. The symptoms of heat cramps are as follows:

- Pain and cramps in legs or abdomen
- Faintness
- Profuse perspiration

Heat Stroke

Heat stroke is a breakdown of the body heat-regulating mechanism causing high fever and collapse. This condition can result in unconsciousness, convulsions, and even death. Persons in poor physical condition or of advanced age are particularly susceptible. The symptoms of heat stroke are:

- Muscle twitching or convulsions
- Dry hot skin
- Flushed skin
- Suddenness of condition
- High body temperature
- Loss of consciousness
- Deep breathing, then shallow or absent
- Dilated pupils

Heat stroke is a serious condition and the individual should be transported to a medical facility as soon as possible. In the interim, steps can be taken to help the patient. The individual should be removed to a cool environment and the body temperature should be reduced promptly by dousing the body with water or by wrapping in a wet sheet. If ice is available, it should be placed under arms and around neck and ankles. "Gatorade" or other liquid containing electrolytes should be provided. Intake of these liquids will be monitored by the site safety coordinator so as not to be excessive. Steps should be taken to protect patient from injury during convulsions, especially from biting the tongue.

To avoid problems from heat stress during conditions of high temperature and humidity, the safety coordinator should assure that employees drink plenty of electrolyte fluids; should provide breaks, as necessary, and should revise work schedules to take advantage of the cooler parts of the day. Some basic guidelines for maintaining workers' body fluids at normal levels during conditions of high temperature and humidity are as follows:

- have workers drink 16 ounces of fluid before beginning work.
- have workers drink 4 to 8 ounces of fluid every 15 to 20 minutes, or at each scheduled break. A total of 1 to 1.6 gallons of fluid per day are recommended, but more may be necessary to maintain body weight.

To measure the effectiveness of the heat recovery rest periods, the employee heart rate should be monitored as follows:

- Count the pulse rate for the last 30 seconds of the first minute of a three minute period, the last 30 seconds of the second minute, and the last 30 seconds of the third minute.
- Double the count to obtain a equivalent one minute rate.

If the first rate is less than 100 beats/minute and the second two readings are at least 10 beats/minute less than the previous reading, then the rest periods should be considered adequate. Otherwise, the rest periods should be extended.

Another method of measuring the effectiveness of the rest periods is to take oral temperatures. If body temperature exceeds 100°F, then the rest periods should be extended.

If heat stress may be a factor due to ambient temperature and humidity, then it is recommended that both methods be used. Also, these tests should be performed in the morning prior to any work to establish a background level.

Cold Stress

Fatal exposures to cold among workers almost always result from accidental exposures involving failure to escape from low environmental air temperatures or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia (cold stress) is the fall in the deep core temperature of the body. Workers should be protected from exposure to cold so that the deep core temperature does not fall below 36°C (96.8°F); lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 35°C (95°F). This must be taken as a sign of danger to the workers and exposure to cold should be immediately terminated for all workers when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

Since prolonged exposure to cold air or to immersion in cold water at temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided. Adequate insulating clothing to maintain core temperatures above 36°C must be provided to workers if work is performed in air temperatures below 4°C (40°F). In addition, it should be kept in mind that, the higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required.

Special protection of the hands is required to maintain manual dexterity for the prevention of accidents:

1. If fine work is to be performed with bare hands for more than 10-20 minutes in an environment below 16°C (60°F), special provisions should be established for keeping the workers' hands warm. Metal handles or tools and control bars should be covered with thermal insulating material at temperatures below -1°C (30°F).
2. If the air temperature falls below 16°C (60°F) for sedentary, 4°C (40°F) for light, -7°C (20°F) for moderate work and fine manual dexterity is not required, then gloves must be used by the workers. Winter "Monkey-grip" gloves consisting of a cotton lining with a textured PVC coating are typically used in cold weather. To prevent contact frostbite, the workers should wear anti-contact gloves.

Provisions for additional body protection is required if work is performed in an environment at or below 4°C (40°F). Workers shall wear cold protective clothing appropriate for the level of cold and physical activity:

1. If the air velocity at the job sites is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind shall be reduced by shielding the work area, or by wearing an easily removable outer windbreak layer garment.
2. If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of the clothing in use may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent and the outer wear should be changed as it becomes wetted. The safety coordinator should assure that adequate replacement garments are available for use by the employees.
3. If the available clothing does not give adequate protection to prevent hypothermia or frostbite, the safety coordinator can suspend work on the site until adequate clothing is available or until weather conditions improve.
4. Workers handling evaporative liquids (gasoline, alcohols, solvents, etc.) at air temperatures below 4°C (40°F) shall take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes or "cryogenic fluids" or those liquids with a boiling point only just above ambient temperatures.

APPENDIX B
MATERIAL SAFETY DATA SHEETS

APPENDIX B
MATERIAL SAFETY DATA SHEETS

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<u>COMPOUND</u>	<u>NUMBER</u>
Aroclor 1254 (PCB)	1
Arsenic	2
Benzene	3
Cadmium	4
Chloroform	5
Chromium	6
Copper	7
Dichloroethylene (trans-1,2)	8
Dibenz (a,h) anthracene	9
Dibutyl Phthalate	10
Di (2-ethylhexyl) phthalate	11
1,2-Dichloroethane	12
1,4-Dimethylbenzene	13
Ethyl Benzene	14
Fluoranthene	15
Lead	16
Mercury	17
Methylene Chloride	18
Naphthalene	19
Perchloroethylene	20
Phenol	21
Selenium	22
Toluene	23
1,1,1-Trichloroethane	24
Trichloroethylene	25
Trichlorofluoromethane	26
Xylene	27
Zinc	28

COMPOUND NO. 1

AROCLOR 1254 (PCB)

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 1200

AROCLOR 1254

Date May 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: AROCLOR 1254

DESCRIPTION: Distillation cut of polychlorinated biphenyl (or diphenyl), containing 54% Cl.
OTHER DESIGNATIONS: PCB, an Askarel, PYRANOL, GE Material A13B1, CAS # 027 323 188
MANUFACTURER: Material was a product of Monsanto Co., but dropped in 1977. Except for uses specifically exempted and regulated by EPA (for example power transformers), legal manufacture, distribution in commerce, and use of PCB's in USA ended in 1979 under TSCA.

SECTION II. INGREDIENTS AND HAZARDS

Mixture of Chlorinated Biphenyls, $C_{12}H_{10-x}Cl_x$:

x	Approx. %
2	0.5
3	1
4	21
5	48
6	23
7	6

Includes 69 or more compounds with average of 4.98 Cl atom/molecule. Mixture may contain 0-2 ppm chlorinated dibenzofurans.

%

ca 100

HAZARD DATA

EPA exemption or authorization needed for any measurable exposure*

Rat, Oral LD₅₀
Adult 4-10 g/kg
Weaning 1.2 g/kg

Rat, Intravenous
LD₅₀ 358 mg/kg

Rat, Oral, TDLo
1220 mg/kg/35 wk
(neoplastic effect)

*Current ACGIH 8-hr TWA is 0.5 mg/m³. NIOSH has proposed a 10-hr TWA of 1.0 µg/m³. Materials with over 50 ppm PCB content are regulated for handling, storage, records, and waste disposal. EPA criterion in navigable waters is 0.001 µg/L PCB's.

SECTION III. PHYSICAL DATA

Boiling range at 1 atm, deg C	---- ca 360-390	Specific gravity (65/15.5 C)	-- 1.5
Vapor pressure at 150 C, mm Hg	--- <1	Pour point, deg C	----- 10
Water solubility at 25 C, ppm	---- ca 0.01	Molecular weight (Av)	----- 327
Viscosity at 100 F, cstk	----- ca 460	Partition Coef. (octanol/water)	>10 ⁴

Appearance & Odor: A light yellow, viscous fluid.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
None to boiling point				

Extinguishing Media: Use media appropriate to the surrounding fire conditions. This material has very low combustibility, but it can undergo thermal-oxidative degradation in a fire situation.

Firefighters should use full protective clothing and self-contained breathing equipment when fighting fire where any PCB's are involved.

SECTION V. REACTIVITY DATA

AROCLOR 1254 and other PCB's are nearly inert materials with very high chemical stability; the higher chlorine levels usually give the greater stability. At about 300 to 600 C some PCB's can oxidize to produce chlorinated dibenzofurans which are much greater in toxicity than the PCB's. For complete incineration of PCB's a 2-second dwell time above 2000 F (1090 C) with 3% excess oxygen in the stack is suitable (see Sect. VII). AROCLOR 1254 shows very little degradation after 3 weeks exposure to direct sunlight. PCB's are strongly absorbed on particulates or sediments in aquatic systems (streams, lakes, ocean, etc.). Mixed in activated sludge, biodegradation occurs slowly, but only very slowly or almost not at all with compounds above Cl₄.

SECTION VI. HEALTH HAZARD INFORMATION

TLV (See Sect. II)

PCBs show high levels of bioaccumulation in fatty tissue and very slow metabolism, especially for Cl₅ compounds and above. They have become widely dispersed in world-wide environment and in the food chain (much like DDT) since their introduction in 1929.

Effective control of PCB discharge into the environment began after 1970.

AROCOR 1254 has a low vapor pressure, but it can be irritating to the eyes, nose, and throat if misted or heated to produce vapors. Excessive acute and chronic exposures may cause liver damage. Chronic exposure to or ingestion of PCB's (especially when thermally oxidized) can result in chloracne after 1-6 months. There is some evidence of possible carcinogenic risk and adverse reproductive effects with this material. PCB's may appear in the breast milk of an exposed mother.

FIRST AID:

Skin Contact: Clean exposed skin with waterless cleaner, wipe with a disposable towel then wash with soap and water. Promptly remove contaminated clothing. (Control separate disposal of PCB-contaminated materials.)

Eye Contact: Flush promptly & thoroughly with lots of running water for 15 minutes.

Inhalation: Remove to fresh air. Get medical help if symptoms continue.

Ingestion: Get medical help. NIOSH has recommended that vomiting be induced.

Get medical help in all cases of severe exposure, repeated exposures, or persistent symptoms.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of all PCB spills or leaks. Promptly contain spilled material!

Prevent its release into the environment! Restrict PCB spill area to trained clean-up personnel; use proper protective gear; follow an established emergency plan.

Stop leakage if possible. Pick up spill. Absorb small spills and residues using a powdered, dry clay. Place leaking containers, picked-up PCBs, and PCB-contaminated materials and refuse into approved, properly labeled, closed containers for storage under controlled, EPA regulated conditions prior to disposal. EPA allows approved storage to 1/1/84. (See Sect. IX.) Storage: 40CFR761.42; Annual report: 40CFR761.45

DISPOSAL: Destroy PCB-containing material by burning in an EPA approved facility. Liquid 50-500 ppm PCB material can be burned as above or landfilled if not ignitable. Non-flowing, PCB-contaminated debris can be disposed of in an EPA approved landfill. (See 40CFR 761; Federal Register, Vol. 44, 31551-4, 66989; Vol. 45, 20473.)

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide highly effective local exhaust ventilation (trap for exhaust vapors) especially if this material is heated or misted. Unless authorized by EPA an isolated system must be used for PCBs.

For nonroutine and emergency conditions of exposure use an approved canister respirator or self-contained breathing equipment.

Prevent skin contact for those who work with PCBs. Use neoprene or polyethylene gloves and apron, safety glasses and/or face shield, and other protective clothing as determined by use conditions. An eyewash station and washing facilities should be available to the work area.

Provide for special handling and disposal of PCB-contaminated materials, including paper towels and clothing (see Sect. VII). Provide locker and shower facilities. Workers must be trained for PCB work, and they must follow good hygienic practice.

Provide pre-placement medical exams for workers with emphasis on liver function, skin condition, and reproductive history. Provide annual medical exams for exposed workers.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

PCB materials in containers and in equipment must have proper labeling including the date of storage. Short term (up to 30 days) storage of non-leaking PCBs can be done. Long term storage requires an EPA approved facility, including such criteria as roof and walls to shield from rain, impervious base and diking which will contain 25% of stored volume or twice the volume of the largest container, no drains or openings to allow flow loss, and the base must be located above the 100-year flood water elevation.

Prevent physical damage to containers. Inspect storage frequently.

Prevent skin contact with PCBs, or with solid products contaminated with PCBs. Prevent inhalation of airborne PCBs. Properly contain PCBs until legally disposed of; do not allow them to escape into the environment!

PCBs, and especially used PCBs, can contain higher toxicity contaminants.

DATA SOURCE(S) CODE: 1-6, 20, 26, 31, 36

APPROVALS: MIS
CRD

Industrial Hygiene
and Safety

MEDICAL REVIEW: June 1980

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COMPOUND NO. 2

ARSENIC



J. T. Baker Chemical Co.

222 Red School Lane Phillipsburg, N.J. 08865
24-Hour Emergency Telephone - (201) 859-2151

Chemtrec # (800) 424-9300
National Response Center # (800) 424-8802

MATERIAL SAFETY DATA SHEET

A7440 -02
Effective: 08/15/86

Arsenic, 1000 ppm (0.100% w/v)

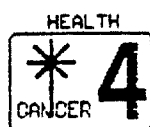
Page: 1
Issued: 12/17/86

SECTION I - PRODUCT IDENTIFICATION

Product Name: Arsenic, 1000 ppm (0.100% w/v)
Formula: As_2O_3 in HCL
Formula Wt: 74.90
CAS No.: 00000-00-0
Product Codes: 6919

PRECAUTIONARY LABELLING

BAKER SAF-T-DATATM System



Laboratory Protective Equipment



Precautionary Label Statements

POISON! DANGER!
CAUSES IRRITATION
MAY BE FATAL IF SWALLOWED

CAUTION: CONTAINS INORGANIC ARSENIC, CANCER HAZARD

Do not get in eyes, on skin, on clothing.
Do not breathe vapor. Keep in tightly closed container. Use with adequate ventilation. Wash thoroughly after handling.

SECTION II - HAZARDOUS COMPONENTS

Component	%	CAS No.
Arsenic Trioxide	0-1	1327-53-3
Hydrochloric Acid (0.3 Molar)	0-1	7647-01-0

SECTION III - PHYSICAL DATA

Boiling Point: 100°C (212°F) Vapor Pressure(mmHg): N/A
Melting Point: 0°C (32°F) Vapor Density(air=1): N/A

Continued on Page: 2

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SECTION III - PHYSICAL DATA (Continued)

Specific Gravity: N/A
(H₂O=1)

Evaporation Rate: N/A
(Butyl Acetate=1)

Solubility(H₂O): Complete (in all proportions) % Volatiles by Volume: ~100

Appearance & Odor: Clear colorless solution with no odor.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A NFPA 704M Rating: 3-0-0

Flammable Limits: Upper - N/A % Lower - N/A %

Fire Extinguishing Media

Use extinguishing media appropriate for surrounding fire.

Special Fire-Fighting Procedures

Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece operated in positive pressure mode.

Toxic Gases Produced

hydrogen chloride

SECTION V - HEALTH HAZARD DATA

This substance is listed as ACGIH suspect human carcinogen, NTP human carcinogen, and IARC human carcinogen (Group 1).

Threshold Limit Value (TLV/TWA): 0.2 mg/m³ (ppm)

Permissible Exposure Limit (PEL): 0.5 mg/m³ (ppm)

Toxicity: LD₅₀ (oral-rat)(mg/kg) - 20

Carcinogenicity: NTP: Yes IARC: Yes Z List: Yes OSHA reg: Yes

Effects of Overexposure

Ingestion is harmful and may be fatal.

Vapors may be irritating to skin, eyes, and mucous membranes.

Inhalation of vapors may cause severe irritation of the respiratory system.

Contact with skin or eyes may cause severe irritation or burns.

Ingestion may cause nausea, vomiting, paralysis.

Ingestion may cause gastrointestinal irritation.



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SECTION V - HEALTH HAZARD DATA (Continued)

Medical Conditions Generally Aggravated By Exposure

None Identified

Routes Of Entry

inhalation, ingestion, absorption, eye contact, skin contact

Emergency and First Aid Procedures

CALL A PHYSICIAN.

If swallowed, if conscious, give large amount of milk, milk of magnesia, or whites of eggs beaten with water. Induce vomiting.

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Flush skin with water.

Toxicity test results and safety and health effects are based on the solute.

SECTION VI - REACTIVITY DATA

Stability: Stable

Hazardous Polymerization: Will not occur

Conditions to Avoid: none documented

Incompatibles: sodium metal, aluminum, strong bases,
strong oxidizing agents, chemically active metals

Decomposition Products: hydrogen chloride

SECTION VII - SPILL AND DISPOSAL PROCEDURES

Steps to be taken in the event of a spill or discharge

Wear self-contained breathing apparatus and full protective clothing. Stop leak if you can do so without risk. Ventilate area. Neutralize spill with soda ash or lime. With clean shovel, carefully place material into clean, dry container and cover; remove from area. Flush spill area with water.

Disposal Procedure

Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number:

P012 (Acute Hazardous Waste)

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

Eye/Skin Protection:

This is a laboratory-use product for which no industrial protective equipment has been

Continued on Page: 4

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SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT (Continued)

designated.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATATM Storage Color Code: Blue

Special Precautions

Keep container tightly closed. Store in secure poison area.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

Proper Shipping Name	Hydrochloric acid, solution
Hazard Class	Corrosive material (liquid)
UN/NA	UN1789
Labels	CORROSIVE
Reportable Quantity	5000 LBS.

INTERNATIONAL (I.M.O.)

Proper Shipping Name	Hydrochloric acid, solution, mixture
Hazard Class	8
UN/NA	UN1789
Labels	CORROSIVE

N/A = Not Applicable or Not Available

The information published in this Material Safety Data Sheet has been compiled from our experience and data presented in various technical publications. It is the user's responsibility to determine the suitability of this information for the adoption of necessary safety precautions. We reserve the right to revise Material Safety Data Sheets periodically as new information becomes available.

COMPOUND NO. 3

BENZENE

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 316

BENZENE

Revision C

Date November 1978

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: BENZENE

OTHER DESIGNATIONS: Benzol, Phenylhydride, Phene, C₆H₆, GE Material D5B53, ASTM D835, D836, D2359, CAS #000 071 432

MANUFACTURER: Available from many sources.

SECTION II. INGREDIENTS AND HAZARDS

	X	HAZARD DATA
Benzene	ca 100	8-hr TWA 10 ppm (skin) with 25 ppm ceiling level and 50 ppm 10 minute peak*
*Current OSHA and ACGIH (1978) permissible exposure level. Note that the OSHA standard on benzene which would reduce the TLV to 1 ppm with a 5 ppm ceiling, forbid contact with liquid with over 0.5% benzene, and legally classify benzene as a human carcinogen has been struck down by U.S. Court of Appeals. ACGIH (1978) lists benzene as a <u>suspected carcinogen</u> for humans.		

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F (C) -- 176 (80)	Specific gravity, 20/4 C -- 0.879
Vapor pressure at 20 C, mm Hg --- 74.6	Volatiles, % ----- ca 100
Vapor density (Air=1) ----- 2.77	Evaporation rate (CCl ₄ =1) - 1.0
Solubility in water, wt. % ----- 0.06	Molecular weight ----- 78.12
	Melting point, deg F (C) -- 42 (5.5)
Appearance & Odor: Clear, colorless liquid having a characteristic aromatic odor. The odor recognition threshold (100% of panel) is 4.68 ppm (unfatigued) in air. Odor is <u>is not</u> an adequate warning of hazard.	

SECTION IV. FIRE AND EXPLOSION DATA

			LOWER	UPPER
Flash Point and Method	Autoignition Temp.	Flammability Limits In Air		
120°F (-11°C) (TCC)	1044°F (562°C)	Volume %	1.3	7.1
Extinguishing Media: Water fog, CO ₂ , dry chemical or foam. Use a blanketing effect to smother fire. A water stream will scatter the fire. A water spray can be used to cool fire exposed containers. Firefighters should wear approved self-contained breathing apparatus. This material can form explosive and flammable mixtures with air at room temperature. It is a <u>severe explosion hazard and toxic hazard</u> in a fire situation. Vapors can flow along surfaces to distant ignition sources and flash back.				

SECTION V. REACTIVITY DATA

Benzene is a stable compound under normal storage and use conditions; it does not polymerize.
Benzene will react vigorously with strong oxidizers such as ozone, permanganate, sulfuric or nitric acids, potassium peroxide, sodium peroxide, et al. It is a flammable liquid.
OSHA Class IB. Heating greatly increases the fire and explosion hazards.
Oxidation in air will produce oxides of carbon and nitrogen.

SECTION VI. HEALTH HAZARD INFORMATION

TLV 10 ppm or 30 mg/m³ (skin)

Excessive inhalation or prolonged skin exposure may cause headache, weariness, loss of appetite and lassitude with incipient blood effects including decreased cell counts, mild lymphotosis and eosinopenia. The most significant toxic effect of benzene is insidious and often irreversible injury to the blood forming tissue from chronic low level exposures. Development of leukemia may occur from chronic excessive exposure! Eye contact yields irritation from liquid or high vapor concentrations. Skin contact will also yield a defatting effect. Inhalation may result in collapse, bronchitis and pneumonia.

FIRST AID:

Eye contact: Wash eyes well with water for 15 minutes. Contact physician.

Skin contact: Wash skin well with water. Contaminated clothing should be removed at once.

Inhalation: Remove victim to fresh air. Restore breathing if required and administer oxygen for labored breathing. Contact physician.

Ingestion: Give edible fats or oils to swallow. Do not induce vomiting (aspiration hazard). Contact a physician immediately.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

If a significant spill occurs, notify safety personnel and evacuate the area. Remove all ignition sources. Provide maximum, explosion-proof ventilation. Clean-up personnel must use approved self-contained breathing apparatus and other protective equipment to avoid contact with benzene.

Remove free liquid. Pick up residue with an inert absorbant, such as vermiculite, and placed in a closed metal container for disposal. using non-sparking tools. When necessary, benzene may be flushed away from a critical area with water, but flush to open area only, not to sewer or to surface waters.

DISPOSAL: Incinerate waste benzene or dispose of via a licensed solvent disposal company. Do not send (or allow run off) to the sewer!

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general ventilation and local exhaust ventilation where benzene is used, handled, or stored to meet TLV requirements. Self-contained breathing apparatus should be available for emergencies and non-routine situations. Approved cartridge or canister type respirators can be used for benzene concentrations up to 50 ppm for short periods. A full facepiece is required above 10 ppm

To prevent skin contact, gloves, aprons, boots, etc of neoprene or other benzene-resistant materials should be used. Chemical goggles or face shields should be used if splashing is possible. Eyewash station should be available where splashing is probable.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Whenever possible, less toxic solvents should be substituted for benzene. Consult health and safety services before benzene is used in plant operations. Do not breathe vapors. Prevent contact with liquid. It is a suspected cancer causing agent!

Keep away from heat, sources of ignition, and oxidizing agents. No smoking in areas of use. Store and handle as OSHA Class IB liquid.

Pre-placement detailed medical examination is needed. Workers who show heart, lung, kidney, liver, nervous disease, or any blood abnormality should not be assigned. Periodic physical examinations and area monitoring is required.

DATA SOURCE(S) CODE: 2-9, 12, 21

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APPROVALS: MIS, CRD

Industrial Hygiene and Safety

Corporate Medical Staff

COMPOUND NO. 4

CADMIUM

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 23

CADMIUM METAL
Revision B

Date December 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: CADMIUM METAL
DESCRIPTION: Silver-white, malleable elemental metal
OTHER DESIGNATIONS: Cadmium Anodes, Cd, GE Material B10C11, ASTM B440, CAS #007 440 439
MANUFACTURER: Available from many suppliers, including:
ASARCO Inc.
120 Broadway Telephone: (801) 262-2459 (Emergency Phone)
New York, NY

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Cadmium	>99.8	8-hr TWA fume 0.1 mg/m ³ } * dust 0.2 mg/m ³ } or 0.05 mg/m ³ ** Human, inhalation TCLo 88 µg/m ³ /8.6 yrs (systemic effect) Rat, intramuscular TDLo 14 mg/kg (carcinogenic effects)

*Current OSHA TLV as developed by ANSI.
**ACGIH TLV (1980) for fume, salt or dust. NIOSH has recommended a 10-hr TWA of 0.04 mg/m³ with a 15 minute ceiling of 0.2 mg/m³.
TLV was set at level to prevent systemic effects of chronic cadmium poisoning.
The massive metal is usually safe unless metal fume is formed (heating) or soluble cadmium compounds are formed (acid reaction or corrosion).

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C (F) -- 767 (1415)	Specific gravity (H ₂ O=1) --- 8.6
Vapor pressure at 394 C, mm Hg----- 1	Melting point, deg C ----- 320.9
Solubility in water ----- Insoluble	Atomic weight ----- 112.41
Viscosity @ 340 C, cp ----- 2.37	Brittle temperature, deg C - 80

Appearance and Odor: Silvery white, bluish, lustrous metal; no odor.

SECTION IV. FIRE AND EXPLOSION DATA

	LOWER	UPPER
Flash Point and Method	Autoignition Temp.	Flammability Limits In Air
Not applicable	570 C* 250 C* (Cloud) (dust layer)	Dust Cloud*

Extinguishing Media: CO₂ or dry chemical type; sand can be used.
Cd dust will burn with evolution of CdO fumes; it is a weak fire and explosion hazard.
Firefighters must wear self-contained breathing apparatus and full protective clothing.

*Through 74 µm sieve; cloud can be ignited by 4.0J spark.

SECTION V. REACTIVITY DATA

Massive metal is stable at room conditions when dry; when, at red heat it oxidizes in air to CdO. Finely powdered metal can be pyrophoric. Heat treatment, welding, or soldering of cadmium metal and cadmium coatings will produce toxic CdO and Cd metal fumes.
The sulfide, carbonate and hydroxide are insoluble in water while the halides, nitrate and sulfate are relatively soluble. Cd forms a variety of soluble complexes such as cyanide & amines. Soluble in acids. Resistant to alkalis. Tarnishes in moist air.
Ammonium nitrate & powdered Cd may yield an explosive reaction. It is incompatible with strong oxidizing agents, elemental sulfur, selenium, tellurium, and hydrazoic acid.
Nitryl fluoride passed over a mildly warm Cd metal can produce incandescence.

SECTION VI. HEALTH HAZARD INFORMATION	TLV (See Sect. II)
<p>Exposures to cadmium dust/fume can result in pulmonary irritation, dermatitis, or allergic sensitization. Pneumonitis can occur after excessive inhalation at 0.5 to 2.5 mg/m³. Fatal pulmonary edema (delayed effects) can result from levels which provide insufficient discomfort for warning; for example, at or above 5 mg/m³ for 8 hrs or at 40-50 mg/m³ for 1 hr. Symptoms of overexposure can be a dry, burning throat, headache, muscle aches, cough, chest tightness and pain, nausea, chills and fever. Chronic exposure, low level fume, may lead to emphysema, anemia, kidney damage, anorexia, and yellow rings around the necks of teeth. Cadmium can be toxic by ingestion.</p>	
<p>FIRST AID:</p> <p><u>Eye Contact:</u> Flush with running water for 15 minutes, including under eyelids.</p> <p><u>Skin Contact:</u> Wash contact area well with soap and water.</p> <p><u>Inhalation:</u> Remove victim to fresh air. Restore breathing if required; have trained person administer 60-100% oxygen. Contact physician or hospital.</p> <p><u>Ingestion*:</u> Contact physician for gastric lavage followed by saline catharsis. (If physician not readily available, give 2-3 glasses water to drink and induce vomiting.) Obtain medical assistance for treatment, observation, and support as needed.</p>	
<p>*Chelating agents used by physicians in cadmium poisoning: Calcium disodium edetate or penicillamine. †Latent period of up to 12 hours.</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Notify safety personnel of spills. Clean-up personnel need protection against inhalation of dust or fumes. Pick up material using vacuum or wet mopping or sweeping to avoid dusting.</p> <p>DISPOSAL: Recover scrap metal and store in closed container for salvage. When possible, return cadmium materials to supplier for reclamation. Incineration can be a cause of air pollution; proper scrubber needed. Conc. soluble Cd waste can be precipitated with lime and collected by filtration. Effluent is treated further as needed to reduce Cd conc. to compliance levels. Cadmium compound containing waste (EPA number D006 under RCRA) to be disposed in an approved chemical landfill of the California Class I type. Follow Federal, State and Local regulations. Toxic to fish. (Conc. greater than 0.001 mg/L; depends on pH).</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Provide efficient local exhaust ventilation to meet TLV requirements in the workplace. Approved respirator protection required when heating, grinding, and for operations where dust and/or fume exposure may occur. A self-contained or air supplied respirator can be used up to 2 mg/m³ with a full face piece above 0.4 mg/m³. (Above 2 mg/m³ a positive pressure mode or auxiliary air supply is needed, respectively.)</p> <p>Wear rubber gloves, chemical goggles and/or face shield and protective coveralls. Special work clothing and laundering recommended. Change work clothing daily; shower after work.</p> <p>Provide periodic medical examinations for those regularly exposed, including chest x-ray, vital capacity, and urinalysis. Preclude from exposure those individuals with lung, liver, kidney, and blood ailments until approved by physician.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Store in a dry, low fire-risk area; avoid storage conditions where corrosion can occur. Keep powdered metal in closed containers, protected from physical damage. Use good housekeeping practices to prevent accumulation of dust; use good cleaning techniques, such as vacuuming to keep airborne particulate at a minimum. Use nonsparking tools where cadmium particulate is found.</p> <p>Use good hygienic practice in handling cadmium and its compounds. No eating or smoking in work areas.</p> <p>Toxic effects of Cd are influenced by the presence or absence of other elements, such as Zn & Se. As an elemental material, cadmium is not degradable; but it can be isolated as insoluble salts in secure landfills.</p>	
DATA SOURCE(S) CODE: 1-12, 19, 20, 24-27, 31, 37-40	<p>APPROVALS: MIS CRD <i>J. M. Nielsen</i></p> <p>Industrial Hygiene and Safety <i>JW</i> 12-9-80</p> <p>MEDICAL REVIEW: 16 Dec. 1980</p>

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COMPOUND NO. 5

CHLOROFORM

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 315

CHLOROFORM
Revision C

Date August 1979

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: CHLOROFORM

OTHER DESIGNATIONS: Trichloromethane, CHCl_3 , COBEHN Spray-Clean Solvent (Trade name),
CAS# 000 067 663

MANUFACTURER: Available from many suppliers, including Cobehn, Inc., 226 Passaic,
Fairfield, NJ 07006

SECTION II. INGREDIENTS AND HAZARDS

Chloroform plus stabilizer*

*0.5-1% ethyl alcohol or 0.025% amylene.

**ACGIH (1979); labeled as a suspected carcinogen.
NIOSH (1976) recommended a 2 ppm ceiling level and a
suspected carcinogen classification when a high level
of CHCl_3 by gavage was found to cause liver cancer in mice
and kidney tumors in rats. NIOSH also warned of an in-
creased toxic hazard with CHCl_3 when alcohol had been
consumed.

Current OSHA TLV remains at a 50 ppm ceiling limit.

%

ca 100

HAZARD DATA

8-hr TWA 10 ppm**
or 50 mg/m³

Human, oral
LDLo 140 mg/kg

Rat, inhalation
LCLo 8000 ppm/4 hr

Rat (6-15 day preg)
inhalation TCLo
100 ppm/7 hr
(teratogenic)

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F (C) --	142 (61)	Specific gravity, 20/4 C -----	1.489
Vapor pressure at 20 C, mm Hg ---	159	Volatiles, % -----	ca 100
30 C, mm Hg ---	245	Evaporation rate ($\text{CCl}_4=1$) -----	1.18
Vapor density (Air=1) -----	4.13	Freezing point, deg F (C) -----	-82(-63.5)
Solubility in water at 25 C, % --	0.8	Molecular weight -----	119.38

Appearance & Odor: Clear, colorless, volatile liquid with a characteristic "sweetish"
etheral odor.

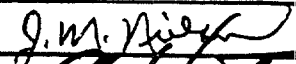

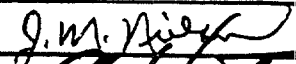

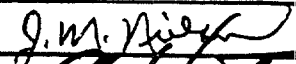

SECTION IV. FIRE AND EXPLOSION DATA

SECTION IV. FIRE AND EXPLOSION DATA			LOWER	UPPER
Flash Point and Method	Autoignition Temp.	Flammability Limits In Air		
None	--	None	--	--

Nonflammable material. Use extinguishing media appropriate for surrounding fire.
When this material is involved in a fire situation, firefighters should use self-contained
breathing apparatus for protection against suffocating vapors and toxic and corrosive
decomposition products.

SECTION V. REACTIVITY DATA

Chloroform is stable in a sealed container in the dark. Even when stabilized with ethanol,
it develops acidity from prolonged exposure to air and light.
Thermal-oxidative decomposition at high temperature can generate toxic and corrosive
oxides of chlorine and carbon, hydrogen chloride, and chlorine.
Avoid contact with strong alkalis.

SECTION VI. HEALTH HAZARD INFORMATION	TLV 10 ppm or 50 mg/m ³				
<p>Excessive inhalation can cause headache, fatigue, dizziness, mental dullness, nausea & unconsciousness. At high concentrations it can cause death from heart arrhythmias and from kidney and liver disorders. Eye contact with liquid or high vapor concentrations can cause pain and irritation, but serious damage is not expected. Skin contact will cause defatting and possible irritation from prolonged contact. Ingestion will cause severe burning of the mouth and throat. Liver damage and loss of consciousness may result from a large ingestion (4 oz.). It is a suspected carcinogen for man.</p> <p>FIRST AID:</p> <p><u>Skin Contact:</u> Wash with soap and water; replace skin oils with creams or lotions.</p> <p><u>Eye Contact:</u> Wash eyes well with plenty of water for 15 minutes. Get medical help.</p> <p><u>Inhalation:</u> Move patient to fresh air. Restore or support breathing as necessary. Obtain medical attention for serious exposure.</p> <p><u>Ingestion:</u> Give 3 glasses milk or water and induce vomiting if conscious. Repeat if large quantities were ingested. Get medical attention!</p>					
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES					
<p>Notify safety personnel and provide adequate ventilation. Workers involved in clean-up must use protection against skin contact and self-contained breathing apparatus. Cover spill with an inert solid absorbent; scoop up into metal container with a cover to prevent evaporation. The absorbed material may be spread on a level site outdoors (away from buildings and people) to evaporate. Smaller spills may be evaporated in a fume hood.</p> <p>DISPOSAL: Scrap liquid can be disposed of via a licensed waste disposal company or it can be redistilled, or it can be mixed with a more flammable liquid and burned in an approved incinerator with afterburner and scrubber. Follow Federal, State and local regulations.</p>					
SECTION VIII. SPECIAL PROTECTION INFORMATION					
<p>Provide general and exhaust ventilation to meet TLV requirements. Maintain hood velocities >100 fpm in areas of chloroform use. Design hoods to catch the heavy vapors. (Exhausts for enclosed areas or below ground should be installed at the lowest point.) Test the atmosphere of enclosed area before entering to ensure safe working conditions. Gloves and aprons (Buna, PVA, or neoprene) should be used to prevent skin contact. Safety showers and eyewash stations should be available.</p> <p>Use of air-supplied or self-contained respirators <u>only</u> is recommended by NIOSH for concentrations above the TLV.</p>					
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS					
<p>Store in sealed containers below 86 F (30 C) away from light. Protect containers from damage.</p> <p>Use with adequate ventilation. Do not use near open flames or sparks as toxic and corrosive decomposition products may form. Do not use rubber or plastic hose or pipe for transfer. Prevent skin and eye contact. Avoid inhalation of vapors.</p> <p>Simultaneous exposure to chloroform and alcohol can increase the toxic hazards of chloroform. Use chloroform with respect and caution, since it is a suspected carcinogen.</p> <p>Provide preplacement & periodic medical exams for those working with chloroform, including kidney & liver functions, nervous system, skin, & any history of alcoholism.</p>					
DATA SOURCE(S) CODE: 1-9.12.20.26	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;"> APPROVALS: MIS, CRD Industrial Hygiene and Safety </td> <td style="padding: 5px; text-align: center;">   </td> </tr> <tr> <td colspan="2" style="padding: 5px; text-align: center;"> MEDICAL REVIEW: 12/79 </td> </tr> </table>	APPROVALS: MIS, CRD Industrial Hygiene and Safety	 	MEDICAL REVIEW: 12/79	
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COMPOUND NO. 6

CHROMIUM

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 83

CHROMIUM METAL/POWDER

Date March 1981

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: CHROMIUM METAL/POWDER

OTHER DESIGNATIONS: Chrome, Cr, ASTM A481, CAS #007 440 473, GE Materials B10D1, B50T2005

MANUFACTURER: Available from many suppliers.

SECTION II. INGREDIENTS AND HAZARDS

Chromium

>99

HAZARD DATA

8-hr TWA 1.0 mg/m³*

Rat, Intravenous
TDLo 2 mg/kg/6W-I
Neoplastic effects

Rat, Implant
TDLo 1 mg/kg/6W-I
Neoplastic effects

*Current OSHA standard for chromium metal and insoluble salt. ACGIH (1980) TLV Intended Changes List, 0.5 mg/m³

TLV set at a level to prevent pulmonary disease.

Status: Publication of a proposed regulation in summer of 1981 is anticipated. (BNA Reporter 12/11/80 pg 756)

SECTION III. PHYSICAL DATA

Boiling point, deg C ----- 2200

Specific gravity @ 20 C ----- 7.19

Vapor pressure, 1 mm Hg, deg C - 1616

Melting point, deg C ----- 1890

Vapor density (Air=1) ----- 1.79

Atomic weight ----- 52

Soluble in H₂O, g/100g ---- Insoluble

Appearance and Odor: Steel-gray, no odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method

Autoignition Temp.

Flammability Limits in Air

LOWER UPPER

580 C* 400 C*
(cloud) (dust layer)

Dust cloud explosion*

0.230
oz/ft³

Extinguishing Media: (Obtain detailed fire-fighting information from supplier.)

Powdered form is combustible. Use water spray or fog, dry chemical, CO₂, sand.

When powdered chromium is exposed to heat or ignition sources it is a moderate fire and explosive hazard. Index of explosibility (<.1 weak, >10 severe) 0.1. Particle size and dispersion in air determine reactivity.

Firefighters should wear self-contained breathing apparatus.

*100% of dust goes thru a 74 micron sieve. Can be ignited by a 140 millijoule spark.

SECTION V. REACTIVITY DATA

This metal is stable when properly stored and handled.

Reacts readily with dilute acids (not nitric) to form chromous salts. Soluble in acids (not nitric) and strong alkalis. Not oxidized by air, even in presence of noticeable moisture. Powder is incompatible with strong oxidizing agents, including high O₂ conc. Evaporation of Hg from Cr amalgam leaves pyrophoric chromium. Finely divided Cr attains incandescence with nitrogen oxide, potassium chlorate, sulfur dioxide.

Fused ammonium nitrate below 200 C reacts explosively; Cr dust (when heated) suspended in CO₂ is ignitable and explosive.

Molten lithium at 18 C attacks Cr severely. At high temperature, oxidation of metal may produce toxic chromium oxide fumes (See MSDS #5).

SECTION VI. HEALTH HAZARD INFORMATION

TLV (See Sect. II)

Chromium metal is relatively nontoxic. Inhalation hazard of powders is dependent upon particle size. Chromium metal and insoluble salts are said to be involved in histological fibrosis of the lungs. (Ref. 31). When metal is heated to a high temperature, fumes produced may be damaging to the lungs when inhaled (possible pneumoconiosis?). Dusts or powder can cause eye and skin irritation.

FIRST AID:

Eye Contact: Flush with running water for 15 minutes, including under eyelids.

Inhalation: Remove victim to fresh air. Restore and/or support breathing as required.

Ingestion: Give water to drink. Induce vomiting.

Seek prompt medical help for further treatment, support, and observation.

Skin: Brush off chromium dust. Wash well with soap and water.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of large spills. Remove sources of heat or ignition. Provide adequate ventilation. Keep airborne dust at a minimum. Clean up personnel to wear protective clothing and approved respirator. Remove spills quickly and place in appropriate containers for disposal or reuse.

DISPOSAL: Reclaim salvageable metal. Place waste in approved secure landfill.* Or incinerate with approved air pollution controls. Follow Federal, State, and Local regulations.

*California Class I.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements in the workplace. Respiratory protection (MESA/OSHA approved) equipment necessary for certain work situations. Respiratory protection in the form of a self-contained breathing apparatus with a full facepiece to be used when the particle concentration's upper limit is 50 mg/m³. Avoid eye contact by use of chemical safety goggles where dusty conditions occur. Wear protective clothing appropriate for the work situation to minimize skin contact. Clothing to be changed daily and laundered. Showering after work with a complete change to street clothing is desirable.

Eyewash stations should be readily accessible in areas of use of powdered chromium. Provide preplacement and periodic medical examinations for those regularly exposed to chromium dust or fume with emphasis on respiratory systems.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS (for chromium powder)

Store material in cool, dry, well-ventilated area. Away from heat or ignition sources. Use good housecleaning practices to prevent accumulation of dust and follow cleaning techniques (vacuuming and wet sweeping) that will keep airborne particulate at a minimum. Use nonsparking tools and ground electrical equipment and machinery. Avoid inhalation of dust. Minimize skin contact by using rubber gloves and aprons. Wash thoroughly after handling. Store separate from acids and oxidizing agents. Keep containers closed and protect from physical damage.

DATA SOURCE(S) CODE: 2-7,9-12,25,26,31,37-44

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APPROVALS: MIS
CRD

Industrial Hygiene
and Safety

MEDICAL REVIEW: 23 March 1981

COMPOUND NO. 7

COPPER

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION

1145 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854



MSDS # 162
COPPER (SCRAP - GENERIC)

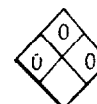
Issued: December 1985
Revised:

From Genium's MSDS Collection, to be used as a reference.

SECTION 1. MATERIAL IDENTIFICATION

18

MATERIAL NAME: COPPER (SCRAP-GENERIC)
OTHER DESIGNATIONS: Copper (Cu) Metal, Casting, or Powder Scrap
DESCRIPTION: Copper or Copper Alloy.
MANUFACTURER: Available from several suppliers.



R 1
I 3
S 1
K 0

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
BASE METAL: Copper (Cu) CAS #7440 50 8	100% maximum	*PEL (OSHA): 0.1 mg/m ³ **TLV (ACGIH): 0.2 mg/m ³ (as copper fume) ----- *PEL (ACGIH): 1.0 mg/m ³ **TLV (ACGIH): 1.0 mg/m ³ (as copper dust or mist) ----- Rat, oral TDLo: 152 mg/kg ----- Human, oral TDLo: 120 mg/kg

* OSHA Permissible Exposure Limit (PEL)
** American Conference of Governmental Industrial Hygienists (ACGIH)
Threshold Limit Values (TLV's) current as of revision date.

SECTION 3. PHYSICAL DATA

Boiling Point @ 1 atm ~2500°C
Vapor Pressure @ 20°C (mm Hg) ... N/A
% Volatile by Volume N/A
Melting Point Approx. 1100°C
Solubility in Water Insoluble
Evaporation Rate (BuAc=1) ... N/A
APPEARANCE & ODOR: Solid, various shapes, odorless, red/brown-colored metal or powder.

SECTION 4. FIRE AND EXPLOSION DATA

			Lower	Upper
Flash Point and Method	Autoignition Temp.	Flammability Limits in Air		
None	None	None	NA	NA

EXTINGUISHING MEDIA: Will not burn. Use water to cool.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Fine metal particles produced when ground, sawed, etc., can burn. High concentration of fines (fine particles) in the air may present an explosion hazard. Good housekeeping and adequate ventilation is recommended. Use air-supplied or self-contained breathing apparatus if fires are in enclosed areas.

SECTION 5. REACTIVITY DATA

This material is stable under most conditions. No hazardous polymerization or explosion conditions exist for the bulk metal.

INCOMPATIBILITIES: Strong acids

DECOMPOSITION PRODUCTS: Metallic oxides (copper fumes)

SECTION 6. HEALTH HAZARD INFORMATION

TLV

See Section 2

Copper scrap is poorly absorbed through the skin or alimentary tract, and while in the solid state it is not considered a hazard. Operations such as welding, dust generation, or fume generation could allow exposure to copper dusts and fumes. Therefore, it is important to maintain exposure levels below the regulated levels as noted in Section 2. Determine actual exposures by industrial hygiene monitoring.

Short-term exposure to copper dusts or fumes may cause irritation of the upper respiratory tract and "metal fume fever," a transient condition with symptoms of fever and chills. Chronic or long-term exposure may result in lung X-ray changes not associated with harmful effects.

FIRST AID:

EYE CONTACT: Protect eyes from particles or fumes. Wash exposed eyes with copious amounts of water for at least 15 minutes.

SKIN CONTACT: Protect skin from molten metal and radiant heat when melting scrap. Skin contamination from powder may be cleaned with soap and water. Machine turnings may present a laceration hazard.

INHALATION: Move to fresh air, restore or support breathing as required.

INGESTION: NA

Copper has not been identified as a carcinogen by NTP, IARC or OSHA.

SECTION 7. SPILL, LEAK AND DISPOSAL PROCEDURES

Copper scrap is normally recycled or sold as scrap or landfilled if recycling cannot be justified. Clean up dust/powder spills promptly by vacuum and wet cleaning methods. Treat as an inert solid. Dispose of in accordance with OSHA, EPA, state, or local regulations.

SECTION 8. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: Use NIOSH/MSHA-approved dust/fume respirator or air-supplied respirator if concentrations of copper in air exceed the regulated standards. Use air-supplied or self-contained breathing apparatus (SCBA) in confined spaces.

VENTILATION: Use only with adequate ventilation where respirable dusts/mists/fumes are possible. Use local exhaust ventilation when cutting, grinding, welding, or remelting.

EYE PROTECTION AND PROTECTIVE CLOTHING: Protect skin from cuts and from hot procedures and processes.

Eye and face protection required when grinding, welding, cutting or remelting. Maintain good hygiene and safe work processes. Scrap from machining may be contaminated with cutting oils. When handling oil-contaminated copper, wear rubber gloves to prevent skin contact.

Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Always maintain exposures below the PEL/TLV. Use industrial hygiene air monitoring to ensure that your use of this material does not create a hazard. Always use exhaust ventilation when feasible.

DATA SOURCE(S) CODE (See Glossary) 1-12, 14, 19, 20, 30, 31, 40, 59, OW

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APPROVALS *JOR* December 3, 1986

INDUST. HYGIENE/SAFETY *JW* 3-86

MEDICAL REVIEW: *MS* May 86

COMPOUND NO. 8

TRANS-1,2-DICHLOROETHYLENE

CHEMICAL NAME: TRANS-1,2-DICHLOROETHYLENE

FORMULA: C2H2CL2

SYNONYMS

ETHYLENE, 1,2-DICHLORO-, (E)-	(E)-1,2-DICHLOROETHENE
TRANS-ACETYLENE DICHLORIDE	TRANS-1,2-DICHLOROETHENE
TRANS-DICHLOROETHYLENE	(E)-1,2-DICHLOROETHYLENE
1,2-DICHLOROETHYLENE	OHS23670
ETHENE, TRANS-1,2-DICHLORO-	

PERMISSIBLE EXPOSURE LIMIT

NONE ESTABLISHED

CERCLA HAZARD RATINGS - TOXICITY 2 - IGNITABILITY 3 - REACTIVITY 0 -
PERSISTENCE 0

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONCENTRATION

NONE SPECIFIED

PHYSICAL DESCRIPTION

COLORLESS LIQUID, PLEASANT ODOR

CHEMICAL AND PHYSICAL PROPERTIES

MOLECULAR WEIGHT: 96.94
BOILING POINT AT 1 ATM, F: 118 F
SOLUBILITY IN WATER, G/100 G WATER AT 20C: SLIGHTLY SOLUBLE
FLASH POINT, CLOSED CUP, F (OR OPEN CUP IF OC): 36 F
VAPOR PRESSURE @ 20 C, MMHG: 400 MM AT 87 F
MELTING POINT, F: -58 F
UPPER EXPLOSIVE LIMIT IN AIR, % BY VOLUME: 12.8 %
LOWER EXPLOSIVE LIMIT IN AIR, % BY VOLUME: 9.7 %
AUTOIGNITION TEMPERATURE: 860 F
SPECIFIC GRAVITY: 1.2565

INCOMPATIBILITIES

THERMAL DECOMPOSITION PRODUCTS ARE HAZARDOUS AND/OR TOXIC
ACETYLENE GAS

PERSONAL PROTECTIVE EQUIPMENT

PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

EMPLOYERS SHALL ENSURE THAT CLOTHING WET WITH THIS SUBSTANCE IS PLACED
IN CLOSED CONTAINERS FOR STORAGE UNTIL IT CAN BE DISCARDED OR UNTIL THE
EMPLOYER PROVIDES FOR THE REMOVAL OF THE CONTAMINANT FROM THE CLOTHING.
IF THE CLOTHING IS TO BE LAUNDERED OR OTHERWISE CLEANED TO REMOVE THE
CONTAMINANT, THE EMPLOYER SHALL INFORM THE PERSON PERFORMING THE
CLEANING OPERATION OF THE HAZARDOUS PROPERTIES OF THE SUBSTANCE.
PROTECTIVE CLOTHING AND EQUIPMENT NECESSARY TO PREVENT REPEATED OR

PROTECTIVE RATINGS BY INDEPENDENT VENDORS AGAINST
DICHLOROETHYLENE (ALL ISOMERS):

EXCELLENT/GOOD:

NONE INDICATED

FAIR/GOOD:

CHLORINATED POLYETHYLENE
POLYVINYL CHLORIDE

GOGGLES

EMPLOYERS SHALL PROVIDE AND ENSURE THAT EMPLOYEES USE SPLASH-PROOF SAFETY GOGGLES WHERE THIS LIQUID MAY CONTACT THE EYES.

WASHING CHEMICALS FROM THE SKIN

EMPLOYERS SHALL ENSURE THAT EMPLOYEES WHOSE SKIN BECOMES CONTAMINATED WITH THIS SUBSTANCE PROMPTLY WASH OR SHOWER WITH SOAP OR MILD DETERGENT AND WATER TO REMOVE ANY CONTAMINANT FROM THE SKIN.

CLOTHING REMOVAL FOLLOWING ACCIDENTAL CONTAMINATION

EMPLOYERS SHALL ENSURE THAT ANY CLOTHING WHICH BECOMES WET WITH THIS FLAMMABLE LIQUID BE REMOVED IMMEDIATELY AND NOT REWORN UNTIL THE SUBSTANCE IS REMOVED FROM THE CLOTHING.

SPECIFIC EMERGENCY PROVISIONS

NONE REQUIRED

RESPIRATOR SELECTION (UPPER LIMIT DEVICES PERMITTED)

NO SPEC ADVISE

- CHEMICAL CARTRIDGE RESPIRATOR
WITH AN ORGANIC VAPOR CARTRIDGE

HIGH LEVELS

- SELF-CONTAINED BREATHING APPARATUS
WITH A FULL FACE-PIECE

FIREFIGHTING

- SELF-CONTAINED BREATHING APPARATUS
WITH A FULL FACE-PIECE
OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE

ROUTE OF ENTRY INTO BODY

INHALATION
INGESTION

SYMPTOMS

EYE IRRITATION	CONJUNCTIVITIS
NAUSEA	DIZZINESS
VOMITING	NARCOSIS
VERTIGO	TREMORS
CENTRAL NERVOUS SYSTEM DEPRESSION	ABDOMINAL CRAMPS

FIRST AID PROCEDURES FOLLOWING EXPOSURE

IF THIS CHEMICAL GETS INTO THE EYES, IMMEDIATELY WASH THE EYES WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE LOWER AND UPPER LIDS. GET MEDICAL ATTENTION IMMEDIATELY. CONTACT LENSES SHOULD NOT BE WORN WHEN WORKING WITH THIS CHEMICAL.

IF THIS CHEMICAL GETS ON THE SKIN. IMMEDIATELY WASH CONTAMINATED SKIN WITH SOAP OR MILD DETERGENT & WATER. IF THIS CHEMICAL SOAKS CLOTHING, IMMEDIATELY REMOVE CLOTHING & WASH SKIN WITH SOAP OR MILD DETERGENT & WATER. GET MEDICAL ATTENTION PROMPTLY.

IF A PERSON BREATHES IN LARGE AMOUNTS OF THIS CHEMICAL, MOVE THE EXPOSED PERSON TO FRESH AIR AT ONCE. IF BREATHING HAS STOPPED PERFORM ARTIFICIAL RESPIRATION. KEEP THE AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION AS SOON AS POSSIBLE.

WHEN THIS CHEMICAL HAS BEEN SWALLOWED AND PERSON IS CONSCIOUS, IMMEDIATELY GIVE PERSON LARGE QUANTITIES OF WATER. AFTER WATER HAS BEEN SWALLOWED, TRY TO GET THE PERSON TO VOMIT BY HAVING HIM TOUCH THE BACK OF HIS THROAT WITH HIS FINGER. DO NOT MAKE AN UNCONSCIOUS PERSON VOMIT. GET MEDICAL ATTENTION IMMEDIATELY.

ORGANS

CENTRAL NERVOUS SYSTEM

EYES

GASTROINTESTINAL

FOLLOWING INFORMATION FROM BUREAU OF EXPLOSIVES "EMERGENCY HANDLING OF HAZARDOUS MATERIALS":

IF MATERIAL ON FIRE OR INVOLVED IN FIRE:

- * DO NOT EXTINGUISH FIRE UNLESS FLOW CAN BE STOPPED
- * USE WATER IN FLOODING QUANTITIES AS FOG
- * SOLID STREAMS OF WATER MAY BE INEFFECTIVE
- * COOL ALL AFFECTED CONTAINERS WITH FLOODING QUANTITIES OF WATER
- * APPLY WATER FROM AS FAR A DISTANCE AS POSSIBLE
- * USE ALCOHOL FOAM OR CO2 OR DRY CHEMICAL EXTINGUISHERS

IF MATERIAL IS NOT ON FIRE AND IS NOT INVOLVED IN FIRE:

- * KEEP SPARKS, FLAMES AND OTHER IGNITION SOURCES AWAY
- * KEEP MATERIAL OUT OF WATER SOURCES AND SEWERS
- * BUILD DIKES TO CONTAIN FLOW AS NECESSARY
- * ATTEMPT TO STOP LEAK IF WITHOUT HAZARD
- * USE WATER SPRAY TO KNOCK DOWN VAPORS

PERSONNEL PROTECTION:

- * AVOID BREATHING DUST/VAPORS/FUMES FROM MATERIAL
- * KEEP UPWIND
- * WEAR BOOTS, PROTECTIVE GLOVES AND GAS TIGHT GOGGLES
- * DO NOT HANDLE BROKEN PACKAGES WITHOUT PROTECTIVE EQUIPMENT
- * WASH AWAY ANY MATERIALS WHICH MAY HAVE CONTACTED THE BODY WITH COPIOUS AMOUNTS OF WATER OR SOAP AND WATER
- * WEAR SELF-CONTAINED BREATHING APPARATUS WHEN FIGHTING FIRES INVOLVING THIS MATERIAL

CAS NUMBER: 156-60-5

REGISTRY TOXIC CHEMICALS NUMBER: KV9400000

COMPOUND NO. 9

DIBENZ (A,H) ANTHRACENE

CHEMICAL NAME: DIBENZ(A,H)ANTHRACENE

FORMULA: C22H14

SYNONYMS

DIBENZO(A,H)ANTHRACENE
1,2:5,6-DIBENZANTHRACENE
1,2,5,6-DBA

DB(A,H)A
OHS06570

PERMISSIBLE EXPOSURE LIMIT

NONE ESTABLISHED (SEE COAL TAR PITCH VOLATILES)

ANIMAL CARCINOGEN (IARC)

SUSPECT HUMAN CARCINOGEN (NTP)

MUTAGENIC DATA (RTEC)

CERCLA HAZARD RATINGS - TOXICITY 3 - IGNITABILITY 0 - REACTIVITY 0 -
PERSISTENCE 3

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONCENTRATION

NONE SPECIFIED

PHYSICAL DESCRIPTION

COLORLESS, CRYSTALLINE SOLID
RED IN SULFURIC ACID SOLUTION

CHEMICAL AND PHYSICAL PROPERTIES

MOLECULAR WEIGHT: 278.36

SOLUBILITY IN WATER, G/100 G WATER AT 20C: 0.0005 MG/L

FLASH POINT, CLOSED CUP, F (OR OPEN CUP IN OC): COMBUSTIBLE

MELTING POINT, F: SUBLIMES 511 F

SPECIFIC GRAVITY: 1.282

INCOMPATIBILITIES: STRONG OXIDIZERS

PERSONAL PROTECTIVE EQUIPMENT

PREVENT SKIN CONTACT, WHERE SKIN CONTACT MAY OCCUR

WEAR IMPERVIOUS CLOTHING

WEAR GLOVES

WEAR FACESHIELD (8 INCH MINIMUM)

PLACE CONTAMINATED CLOTHING IN CLOSED CONTAINERS FOR STORAGE UNTIL
LAUNDERED OR DISCARDED

IF CLOTHING IS TO BE LAUNDERED, INFORM PERSON PERFORMING OPERATION OF
CONTAMINANT'S HAZARDOUS PROPERTIES

GOGGLES

ADVISE EYE PROTECTION TO PREVENT ANY POSSIBILITY OF EYE CONTACT

WEAR FACE SHIELD OR VENTED GOGGLES

WASHING CHEMICALS FROM THE SKIN

ADVISE WASHING SHOWER AT END OF EACH SHIFT

ROUTINE CHANGING OF WORK CLOTHING

ADVISE CHANGING AFTER WORK SHIFT

CLOTHING REMOVAL FOLLOWING ACCIDENTAL CONTAMINATION

**ADVISE REMOVING SHOWER AFTER EACH SHIFT PRIOR TO LEAVING PREMISES
DRY SWEEPING AREA OR DRY MOPPING PROHIBITED - CARCINOGEN**

SPECIFIC EMERGENCY PROVISIONS

CADMIUM CHLORIDE

**EYE-WASH FOUNTAIN WITHIN IMMEDIATE WORK AREA WHERE EMPLOYEES' EYES MAY
BE EXPOSED TO SUBSTANCE**

**QUICK DRENCHING FACILITIES WITHIN IMMEDIATE WORK AREA WHERE EMPLOYEES
MAY BE EXPOSED TO SUBSTANCE**

EATING AND SMOKING SHOULD NOT BE PERMITTED IN IMMEDIATE WORK AREA

WATER FOUNTAIN PROHIBITED IN WORK AREA

CLOSED SYSTEM IF SUBSTANCE TO BE USED

RESPIRATOR SELECTION (UPPER LIMIT DEVICES PERMITTED)

2 MG/M3

- CHEMICAL CARTRIDGE RESPIRATOR
WITH AN ORGANIC VAPOR CARTRIDGE
WITH A FUME OR HIGH-EFFICIENCY FILTER
- SUPPLIED-AIR RESPIRATOR
- SELF-CONTAINED BREATHING APPARATUS

10 MG/M3

- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE WITH A
FULL FACE-PIECE AND WITH A FUME OR HIGH-EFFICIENCY FILTER
- SUPPLIED-AIR RESPIRATOR WITH A FULL FACE-PIECE, HELMET, OR HOOD
- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE

200 MG/M3

- TYPE 'C' SUPPLIED-AIR RESPIRATOR
OPERATED IN PRESSURE-DEMAND, POSITIVE-PRESSURE, OR CONTINUOUS-FLOW MODE
- POWERED AIR-PURIFYING RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE AND WITH
A HIGH-EFFICIENCY PARTICULATE FILTER

400 MG/M3

- TYPE 'C' SUPPLIED-AIR RESPIRATOR WITH A FULL FACE-PIECE
OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE
- TYPE 'C' SUPPLIED-AIR RESPIRATOR WITH A FULL FACE-PIECE OPERATED IN
CONTINUOUS-FLOW MODE

ESCAPE

- GAS MASK
WITH AN ORGANIC VAPOR CANISTER (CHIN-STYLE OR FRONT- OR BACK-MOUNTED
CANISTER) WITH A PARTICULATE FILTER INCLUDING PESTICIDE RESPIRATORS
- SELF-CONTAINED BREATHING APPARATUS

FIREFIGHTING

- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE OPERATED IN
PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE

ROUTE OF ENTRY INTO BODY
INJECTION

SYMPTOMS

BRONCHIAL NEOPLASM IN EXPERIMENTAL ANIMALS

FIRST AID PROCEDURES FOLLOWING EXPOSURE

IF THIS CHEMICAL GETS INTO THE EYES, IMMEDIATELY WASH THE EYES WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE LOWER AND UPPER LIDS. GET MEDICAL ATTENTION IMMEDIATELY. CONTACT LENSES SHOULD NOT BE WORN WHEN WORKING WITH THIS CHEMICAL.

IF THIS CHEMICAL GETS ON THE SKIN, IMMEDIATELY WASH CONTAMINATED SKIN WITH SOAP OR MILD DETERGENT & WATER. IF THIS CHEMICAL SOAKS CLOTHING, IMMEDIATELY REMOVE CLOTHING & WASH SKIN WITH SOAP OR MILD DETERGENT & WATER. GET MEDICAL ATTENTION PROMPTLY.

IF A PERSON BREATHES IN LARGE AMOUNTS OF THIS CHEMICAL, MOVE THE EXPOSED PERSON TO FRESH AIR AT ONCE. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP THE AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION AS SOON AS POSSIBLE.

WHEN THIS CHEMICAL HAS BEEN SWALLOWED AND PERSON IS CONSCIOUS, IMMEDIATELY GIVE PERSON LARGE QUANTITIES OF WATER. AFTER WATER HAS BEEN SWALLOWED, TRY TO GET THE PERSON TO VOMIT BY HAVING HIM TOUCH THE BACK OF HIS THROAT WITH HIS FINGER. DO NOT MAKE AN UNCONSCIOUS PERSON VOMIT. GET MEDICAL ATTENTION IMMEDIATELY.

ORGANS

RESPIRATORY

CAS NUMBER: 53-70-3

REGISTRY OF TOXIC CHEMICALS NUMBER: HN2625000

COMPOUND NO. 10

DIBUTYL PHTHALATE

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 429

DIBUTYL PHTHALATE

Date May 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: DIBUTYL PHTHALATE
OTHER DESIGNATIONS: DBP, Di-n-butyl Phthalate, $C_6H_4(COOC_4H_9)_2$, GE Material D5E6,
ASTM D608, CAS #000 084 742 STAFLEX DBP FLEXOL DBP
MANUFACTURE & TRADE NAME: KODAFLEX DBP Reichhold Chem., Inc. Union Carbide Corp.
Eastman Chem. Prod., Inc. 525 North Broadway 270 Park Ave.
PO Box 431 White Plains, NY 10603 New York, NY 10017
Kingsport, TN 37662 (914) 682-5700 (212) 551-3763
Telephone: (800) 251-0351

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Dibutyl Phthalate	> 99	8-hr TWA 5 mg/m ³ *
Phthalic Acid	< 0.01	No TLV Established
		Human, Oral LDLc 5 g/kg TDLo 140 mg/kg (affected vision)
		Rat (5-15 d pregnant) Interperitoneal LDLo 874 mg/kg (teratogenic effects)

*Current (1979) OSHA and ACGIH TLV.

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C --- 340 Specific gravity (20/20 C) ----- 1.05
Vapor pressure at 115 C, mm Hg -- 0.1 Viscosity at 20 C, cp ----- 20.3
Vapor density (Air=1) ----- 9.6 Freezing point, deg C ----- -35
Water solubility at 20 C, g/liter <0.03 Molecular weight ----- 278

Appearance & Odor: A clear, colorless, nonvolatile, oily liquid; odorless or with a slight aromatic odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
315 F (CC)	757 F	Vol. % (at 456 F)	0.47	--

Extinguishing Media: Use water spray, dry chemical, CO₂, or foam. Water or foam may cause frothing. Use water to cool fire-exposed containers.
This combustible liquid (OSHA Classification IIIB) is a slight fire hazard when exposed to heat or flame. No unusual fire hazard.
Firefighters should use self-contained breathing equipment.

SECTION V. REACTIVITY DATA

Dibutyl phthalate is a stable liquid under normal storage conditions. It does not polymerize.
It is combustible and can react vigorously with oxidizing agents. When heated with chlorine, for example, it can explode.
Strongly acidic or alkaline materials can hydrolyzed the ester to butyl alcohol and phthalic acid (or its salt).

SECTION VI. HEALTH HAZARD INFORMATION

TLV 5 mg/m³

DBP is low in acute oral toxicity [but it has higher toxicity than di-(2-ethylhexyl) phthalate, MSDS #414]. Its low vapor pressure gives a low inhalation hazard unless the material is heated or misted; inhaled vapor or mist can be irritating to the respiratory tract. Liquid contact with the eye can be irritating. After ingestion of 10g of DBP a young male adult experienced nausea and vertigo. Signs of keratitis and excess albumin and blood cells in the urine were observed. Recovery with no after-effects reported. Photophobia has been reported after ingestion.

FIRST AID:

Skin Contact: Wash affected area well with soap and water. Remove contaminated clothing.
Eye Contact: Flush thoroughly with running water, including under eyelids, for 15 minutes. Get medical help.
Inhalation: Remove to fresh air. Get medical help if symptoms persist.
Ingestion: Get medical help for treatment, observation and support. (If the amount swallowed was large and medical help or advice unavailable, give the conscious victim milk or water to drink and induce vomiting.)

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of major spills. Provide ventilation. Contain spills and collect for recovery or disposal. Prevent flushing to the sewer or to a watercourse. Pick up small spills and residues with paper or other absorbent solid for disposal. Those involved in clean-up need protection against contact with liquid and vapor or mist inhalation.

DISPOSAL: Burn waste material and scrap in an approved incinerator. Combustibility may be improved by mixing with more flammable solvents, for example with waste alcohols. Follow Federal, State and Local regulations in disposing of this material.

Note! DBP at low, chronic concentrations may be detrimental to the reproduction processes of aquatic organisms. Because its stability DBP can be persistent in the environment and should be considered an environmental pollutant.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements. When DBP is heated or misted, approved respiratory equipment may be needed on an emergency or nonroutine basis.

Workers should use rubber or neoprene gloves and safety goggles. Additional protection such as apron or face shield should be used where needed to avoid repeated or prolonged skin contact.

An eyewash station and washing facilities should be available where DBP is handled.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area, away from acids, bases and strong oxidizing agents. Protect containers from physical damage.

Since chronic effects are not fully known, follow good hygienic practice. Wear clean work clothing. Wash hands and face after working with this material and before eating or smoking. Avoid prolonged or repeated contact with DBP. Avoid breathing mist or vapors.

Those with kidney impairment or disease should not work with this material without a physician's approval and surveillance, since excretion in the urine is a major elimination path.

Dialkyl phthalates as a class have been recommended for further study of possible environmental effects and chronic toxic effects. Use DBP with care.

DATA SOURCE(S) CODE: 1-12.20.23.25.31

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APPROVALS: MIS
CRD

Industrial Hygiene
and Safety

MEDICAL REVIEW: June 1980

COMPOUND NO. 11

DI (2-ETHYLHEXYL) PHTHALATE

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



NO 414

DI(2-ETHYLHEXYL)PHTHALATE

Revision A

DATE December 1984

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: DI(2-ETHYLHEXYL)PHTHALATE
OTHER DESIGNATIONS: DEHP, "DOP", $\text{o-C}_6\text{H}_4[\text{COOCH}_2\text{CH}(\text{C}_2\text{H}_5)\text{C}_4\text{H}_9]_2$, bis(2-Ethylhexyl)Phthalate,
GE Material D5B9, ASTM D1249 Type I, CAS #000 117 817, Dioctyl Phthalate
TRADE NAME & KODAFLEX DOP
MANUFACTURER: Eastman Chemical Products U.S. Steel Corp. W.K. Grace & Co.
Coatings Chemicals Div. Chemicals Div. Hatco Chemicals Div.
Kingsport, TN 37662 600 Grant Avenue Fords, NJ 08863
Phone: (800)327-8626 Pittsburgh, PA 15230 (201)738-1000
(412)433-7711

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Di(2-ethylhexyl)phthalate	ca 99	6-hr TWA 5 mg/m ³ * Man, Oral TDLo 143 mg/kg GI tract effects Rat (5-15 days Preg.) interperitoneal TDLo 15 g/kg Teratogenic effects Rat, Oral LD ₅₀ 31 g/kg
Listed as a "suspected carcinogen" by the National Toxicology Program (NTP). (Long term, high level animal feeding tests have produced neoplasms.) National Center for Toxicological Research is currently testing (FY1984) for reproductive development toxicity.		
*Current (1984) OSHA PEL and ACGIH TLV. ACGIH STEL is 10 mg/m ³ for 15 minutes exposure		

SECTION III. PHYSICAL DATA

Boiling point, 760 mm, deg C -----	ca 385	Specific gravity, 20/20 C -----	0.99
54 mm, deg C -----	230	Pour point, deg C -----	ca -48
Vapor pressure at 200 C, mm Hg ---	1.3	Viscosity, 20 C, cps -----	81.4
Vapor density (Air=1) -----	~13.5	Freezing point, deg C --	below - 50
Water solubility -----	Nearly insoluble ($<0.01\%$ at 20 C)	Molecular weight -----	390.5

Appearance & Odor: Colorless to pale yellow oily liquid. Odorless to faint, mild odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits in Air	Lower	Upper
425 F (COC)	770 F	Volume % @ 474F (245C)	0.3	-

Extinguishing media: Use foam, water spray, carbon dioxide or dry chemical. Water or foam may cause frothing of hot oil. Use water spray to cool fire-exposed containers of this material and to flush spills away from sensitive area.
This material is a slight fire hazard when exposed to heat or flame; it presents no unusual fire hazard.
Firefighters should use self-contained breathing equipment and full protective clothing.

SECTION V. REACTIVITY DATA

This is a stable material under normal storage and handling conditions. It does not undergo hazardous polymerization.
It is a combustible liquid (OSHA Class III-B) and is incompatible with strong oxidizing agents.
Thermal-oxidative degradation products include carbon dioxide and carbon monoxide.

SECTION VI. HEALTH HAZARD INFORMATION

TLV 5 mg/m³ (See Sect II)

The low vapor pressure of this material essentially eliminates acute inhalation hazard unless the liquid is heated or misted. The TLV has been established to prevent inhaling of excessive levels of airborne DEHP which can cause nausea and be irritating to mucous membranes and the respiratory tract. Eye contact with liquid or mist is irritating. Ingestion can cause abdominal cramps, nausea, and diarrhea. Excessive skin contact can be irritating. (Rabbit, skin, LD₅₀ 25g/kg)

FIRST AID:

Eye Contact: Flush eyes with running water for 15 minutes, including under eyelids. Get medical help if irritation persists.

Skin Contact: Wash exposed areas well with soap and water. Get medical help if irritation persists or if large areas of the body are affected. Remove contaminated clothing promptly.

Inhalation: Remove to fresh air. Support breathing if necessary. Get medical help. Keep warm and at rest.

Ingestion: Contact physician. Stomach lavage may be needed.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Contain spill and pick up with absorbent solid, rags, or paper for disposal by burning. Prevent losses into the environment whenever possible. Do not send to sewer. (DEHP degrades in fresh water sediments under aerobic conditions; half life about 14 days. It does not degrade under anaerobic conditions. It is readily concentrated by aquatic organisms.) Clean up trace residues with water and detergent.

DISPOSAL: Scrap material can be disposed of by controlled incineration. Mix liquid scrap with a more flammable solvent and spray into incinerator's firebox. Follow Federal, State, and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Use general ventilation, combined with local exhaust ventilation (especially when material is heated or misted) to meet the TLV requirements. For nonroutine and emergency conditions where the TLV is exceeded, use an approved air-supplied mask or organic canister respirator for protection against mist and vapors.

Use rubber gloves and apron to avoid repeated or prolonged contact with liquid and safety glasses or goggles to avoid eye contact by splashing. Depending on how the material is used and conditions of use, additional body protection may be desirable.

Eyewash fountain and safety showers should be available to areas of use and handling. DEHP contaminated clothing should be removed and laundered before reuse.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in a ventilated area away from oxidizing agents and sources of heat or ignition. Follow good hygienic practice to avoid chronic effects. Wear clean work clothing.

Avoid prolonged or repeated contact with liquid and inhalation of mist or vapors. Do not eat or smoke in areas where this material is used or stored. Wash exposed skin areas after working with this material and before using restroom facilities, eating or smoking. Do not take internally.

DATA SOURCE(S) CODE: 1-12, 14, 23, 38, 47

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APPROVALS: MIS CRD

INDUST HYGIENE SAFETY

MEDICAL REVIEW

December 1984

COMPOUND NO. 12

1,2-DICHLOROETHANE

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 359

1,2-DICHLOROETHANE

REVISION B

Date November 1978

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: 1,2-DICHLOROETHANE
OTHER DESIGNATIONS: Ethylene dichloride, $\text{ClC}_2\text{H}_4\text{Cl}$, sym-Dichloroethane, Ethylene Chloride, GE Material D5B54, CAS# 000 107 062
MANUFACTURER: Available from several suppliers, including
Dow Chemical Company
1000 Main St.
Midland, MI 48640

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
1,2-Dichloroethane -----	ca 100	8-hr TWA 10 ppm* Human, Inhalation TCLo 4000 ppm/1 hr central nervous system Rat, oral LD ₅₀ 680 mg/kg

*ACGIH 1978 intended changes list TLV. Current OSHA TLV is 50 ppm.
NIOSH (1976) proposed a 10-hr TWA of 5 ppm with a ceiling of 15 ppm (15 minute sample) and has now recommended that the material be handled in the workplace as if it were a carcinogen in man. (NIOSH Current Intelligence Bulletin No. 25 and 27, 1978)

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg F (C) --	182 (83.5)	Specific gravity (20/4C) ---	1.257
Vapor density (Air=1) -----	3.4	Evaporation rate ($\text{CCl}_4=1$) --	1.3
Vapor pressure at 25 C, mm Hg -----	87	Molecular weight -----	98.96
Solubility in water -----	Slight	Freezing point, deg C -----	-35.7

Appearance & Odor: A colorless, oily liquid; chloroform-like odor whose recognition threshold (100% of test panel) is 40 ppm. Odor detection probably indicates an excessive exposure to vapors.

SECTION IV. FIRE AND EXPLOSION DATA

			LOWER	UPPER
Flash Point and Method	Autoignition Temp.	Flammability Limits In Air		
56°F	775°F	% by Volume	6.2	15.9

Extinguishing Media: CO_2 , dry chemical, alcohol foam or water fog. Blanketing effect needed to smother fire. Water may be ineffective but can be used to cool fire-exposed containers.

It is a dangerous fire hazard and a moderate explosion hazard when exposed to heat or flame. Vapors can flow along surfaces to distant ignition sources and flash back. Firefighters should use self-contained breathing apparatus when this material is involved in a fire situation.

SECTION V. REACTIVITY DATA

This solvent is stable at ordinary working conditions. Explosion hazards can exist at elevated temperatures. No hazardous polymerization will occur. It may react vigorously with oxidizing materials. Thermal degradation products include highly toxic fumes of phosgene, oxides of carbon and nitrogen.
Explosions have occurred with mixtures of ethylene dichloride with liquid ammonia or with dimethylaminopropylamine. Finely divided aluminum or magnesium metal may be hazardous in contact with liquid.

SECTION VI. HEALTH HAZARD INFORMATION	TLV 10 ppm or 40 mg/m ³ (See Sect II)						
<p>Inhalation of this solvent can produce irritation and intoxication effects. Systemic toxicity from overexposure occurs in the liver, digestive tract, kidneys, adrenal glands and nervous system. Nausea, vomiting, depression, and diarrhea are signs of intoxication. Skin contact will defat the skin and cause strong irritation or burn on prolonged contact. It is an eye irritant and liquid in the eye can produce serious injury (clouding of cornea) if not removed promptly. Human, oral LDLo is 845 mg/kg.</p> <p>FIRST AID:</p> <p><u>Eye contact:</u> Wash eyes promptly for 15 minutes with running water. Get prompt medical attention!</p> <p><u>Skin contact:</u> Wash contact area with soap and water; replace skin oils with an approved lanolin lotion.</p> <p><u>Inhalation:</u> Remove victim to fresh air. Restore breathing if required. Get medical help.</p> <p><u>Ingestion:</u> Give 3 glasses water or milk. Obtain <u>immediate</u> medical attention for stomach lavage. Induce vomiting when medical help unavailable.</p>							
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES							
<p>Report to safety coordinator. Exclude from area personnel not assigned to clean-up and those without protection against inhalation of vapors and contact with liquid. Provide adequate ventilation. Remove ignition sources. Absorb spill on paper, vermiculite or other absorbent and place in covered metal container for disposal.</p> <p>DISPOSAL: Burn in an approved, scrubber-equipped, incinerator, or (for <u>small amounts only</u>) in an open ditch away from buildings and people. A licensed chemical waste disposal company can also be used. Follow Federal, State and local regulations.</p>							
SECTION VIII. SPECIAL PROTECTION INFORMATION							
<p>Ventilation must meet TLV requirements. Heavy vapors will collect in low areas; use proper hood design for heavy vapors. Exhaust fans should be explosion proof.</p> <p>Use this volatile solvent in properly exhaust ventilated area only; hoods should maintain 100 lfm face velocity minimum. Air supplied or self-contained respirators are needed for non-routine use above TLV and for emergencies.</p> <p>Wear butyl or neoprene gloves to prevent skin contact. Wear goggles or safety glasses in areas of use. Use impervious aprons to prevent skin contact.</p> <p>Provide eye wash stations and safety showers in areas of use.</p>							
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS							
<p>Store in a clean, cool well-ventilated area.</p> <p>Outside or detached storage of this flammable material is preferred. Store small quantities in brown bottles or opaque containers as this solvent is light sensitive. No smoking or other ignition sources in areas of use or storage. Use spark-proof tools. Ground and bond metal containers for liquid transfers to prevent static sparks.</p> <p>Prevent skin contact! Promptly remove contaminated clothing and laundry before reuse. Avoid inhalation of vapors! Handle as a potential carcinogen; limit exposure to as few workers as possible.</p>							
DATA SOURCE(S) CODE: 1-9, 12, 19, 21	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">APPROVALS: MIS, CRD</td> <td style="padding: 2px;"><i>J. M. Nelson</i></td> </tr> <tr> <td style="padding: 2px;">Industrial Hygiene and Safety</td> <td style="padding: 2px;"><i>W. White</i></td> </tr> <tr> <td style="padding: 2px;">Corporate Medical Staff</td> <td style="padding: 2px;"><i>George F. Marttila MD</i></td> </tr> </table>	APPROVALS: MIS, CRD	<i>J. M. Nelson</i>	Industrial Hygiene and Safety	<i>W. White</i>	Corporate Medical Staff	<i>George F. Marttila MD</i>
APPROVALS: MIS, CRD	<i>J. M. Nelson</i>						
Industrial Hygiene and Safety	<i>W. White</i>						
Corporate Medical Staff	<i>George F. Marttila MD</i>						
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COMPOUND NO. 13

1,4-DIMETHYLBENZENE

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 318C

p-XYLENE

Date November 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: p-XYLENE

DESCRIPTION: An Aromatic Hydrocarbon

OTHER DESIGNATIONS: C₆H₄(CH₃)₂, 1,4-Dimethylbenzene, p-Xylol,

CAS #000 106 423

MANUFACTURER: Available from many suppliers, including EXXON Company USA and Shell Chemical Company.



SECTION II. INGREDIENTS AND HAZARDS

Xylene (p-isomer)

Other C₇ to C₉ Hydrocarbons*

*Material may contain ethylbenzene (8-hr TWA 100 ppm) and traces of toluene, C₉ aromatic and aliphatic hydrocarbons.

**Current OSHA standard and ACGIH (1980) TLV. NIOSH recommends a 10-hr workday, 40-hr workweek TWA of 100 ppm and a ceiling level of 200 ppm (10 min. sample).

TLV set at a level to prevent irritant effects and CNS depression. Selected for mutagenicity and teratogenicity testing in FY80 by EPA under TSCA.

~99
<1

HAZARD DATA

8-hr TWA 100 ppm (Skin)**
or 435 mg/m³

Rat, oral
LD₅₀ 5000 mg/kg

Rat, inhalation
LCLo 4912 ppm/24-hr

Goldfish, LD₅₀
18 mg/L, 24 hrs
(ASTM D1345)

SECTION III. PHYSICAL DATA

Boiling point, deg C -----	138	Specific gravity (25/4 C) -----	0.857
Vapor pressure at 25 C, mm Hg ---	8.6	Melting point, deg C -----	12-13
Vapor density (Air=1) -----	3.7	Molecular weight -----	106.17
Solubility in water -----	Insoluble		

Appearance & Odor: Clear, colorless plates or prisms at low temp. A clear, colorless liquid at >13 C. Threshold odor concentration 0.47 ppm.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
25 C (CC)	986 F	%	1.1	6.6

Extinguishing Media: Use dry chemical, foam, Carbon dioxide. A water stream can scatter flames. A water spray may be used to cool fire-exposed containers.

This flammable liquid is a dangerous fire hazard and a moderate explosion hazard when exposed to heat or flame. Heavier-than-air vapors can flow along surfaces to distant ignition sources and flash back.

Firefighters should use self-contained breathing apparatus.

SECTION V. REACTIVITY DATA

This material is stable in closed containers at room temperature. It does not polymerize.

It is flammable (OSHA Class IC liquid) and can form explosive mixtures with air. Keep away from sources of heat, sources of ignition and strong oxidizing agents. Thermal-oxidative degradation in air can produce toxic vapors and gases, including carbon monoxide and oxides of nitrogen.

SECTION VI. HEALTH HAZARD INFORMATION	TLV 100 ppm or 435 mg/m ³
<p>Xylene is toxic by all portals of entry. It is an irritant of the eyes, mucous membrane, and skin; at high conc. it causes narcosis. Percutaneous absorption is slow and can cause a dermatitis attributed to its defatting properties with prolonged contact causing formation of vesicles. Acute exposure to its vapors may cause CNS depression and minor effects upon liver and kidney functions. Conc. >200 ppm can cause anorexia, nausea, vomiting, dyspnea, vertigo, incoordination, and conjunctivitis. Very high conc. can cause chemical pneumonitis and pulmonary edema. Conc. of 10,000-30,000 ppm may produce anesthesia within one minute.</p> <p>FIRST AID:</p> <p><u>Eye Contact:</u> Flush with running water for 15 minutes, including under eyelids.</p> <p><u>Skin Contact:</u> Wash with soap and water. Remove contaminated clothing promptly.</p> <p><u>Inhalation:</u> Remove to fresh air. Restore breathing if required.</p> <p><u>Ingestion:</u> Get medical attention immediately! Give white mineral oil demulcent and saline cathartic, but <u>do not</u> induce vomiting unless directed by a physician.</p> <p>Maintain observation of patient for possible delayed onset of pulmonary edema.</p>	
<p>SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES</p> <p>Notify safety personnel. Remove all ignition sources. Provide adequate ventilation. Use vermiculite or sand to absorb spill; scrape up with nonsparking tools and place in a covered metal container. The absorbed material may be burned in an open pit or placed in cardboard boxes and burned in an incinerator. Spilled liquid can be flushed away from sensitive locations with a water stream; flush to open area <u>not</u> to sewer!</p> <p>DISPOSAL: Atomized into an approved incinerator, or disposed of via a licensed solvent disposal company, or Belliot process for oxidation destruction of gaseous organic cmpds (#20, pg 380). When large amounts are involved reclamation procedures may prove economical. Follow Federal, State, and Local regulations.</p> <p>May be toxic to aquatic life.</p>	
<p>SECTION VIII. SPECIAL PROTECTION INFORMATION</p> <p>Provide general ventilation and efficient exhaust ventilation (explosion-proof equipment to meet TLV requirements and to control heavier-than-air vapors. Use >100 lfm face velocity for exhaust hoods. Respirators to be available for nonroutine or emergency use. When fumes are <1000 ppm, a chemical cartridge respirator with full facepiece and organic vapor canister is warranted; at >10,000 ppm, a self-contained breathing apparatus with full facepiece operated in the positive pressure-demand mode is used. CAUTION! The lower explosive limit is approx. 11,000 ppm.</p> <p>Buna-N rubber gloves and aprons should be worn to prevent contact of xylene with the skin. Safety glasses or goggles should be used for eye protection and eyewash stations should be readily accessible to use areas.</p> <p>Comprehensive preplacement and biennial medical examinations to be directed toward, but not limited to, liver, kidney, gastrointestinal disorders, skin irritation, and the central nervous system.</p>	
<p>SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS</p> <p>Store in closed containers in a clean, cool, well-ventilated area, away from sources of heat, sources of ignition and strong oxidizing agents. Protect containers from physical damage. Bond and ground metal containers when transferring liquid. Use metal safety cans for small amounts. Use nonsparking tools for work in solvent areas. No Smoking in areas of use, storage, or manufacturing.</p> <p>Prevent skin contact and remove contaminated clothing promptly. Avoid repeated or prolonged breathing of vapor. Do not ingest!</p>	
<p>DATA SOURCE(S) CODE: 1-12, 19-21, 23, 26, 31, 34, 37-39</p> <p><small>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</small></p>	<p>APPROVALS: MIS CRD <i>J. M. Niles</i></p> <p>Industrial Hygiene and Safety <i>JW 11-26-80</i></p> <p>MEDICAL REVIEW: December 5, 1980</p>

COMPOUND NO. 14

ETHYL BENZENE

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 385

ETHYL BENZENE

Date August 1978

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: ETHYL BENZENE

OTHER DESIGNATIONS: Phenylethane, Ethylbenzol, $C_2H_5C_6H_5$, CAS# 000 100 414

MANUFACTURER: Available from several suppliers.

SECTION II. INGREDIENTS AND HAZARDS

Ethyl Benzene

%

ca 100

HAZARD DATA

8-hr TWA 100 ppm*

*Current OSHA permissible exposure level. A Standard was proposed by OSHA in October 1975 which includes an action level of 50 ppm, and detailed requirements of monitoring, medical surveillance, employee training, etc.; when exposure exceeds 50 ppm. It has not yet issued as a legal requirement.

Human, inhalation
TCLo 100 ppm for
8 hr (irritation)
Rat, Oral LD50
3500 mg/kg

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C	-- 136	Specific gravity 20/4C	----- 0.867
Vapor pressure at 25.9 C, mm Hg	- 10	Volatiles, %	----- ca 100
Vapor density (Air=1)	----- 3.66	Evaporation rate (BuAc=1)	----- <1
Water solubility at 20 C Wt. %	- 0.015	Melting point, deg C	----- -95
		Molecular weight	----- 106.16

Appearance & Odor: Clear, colorless liquid with an aromatic hydrocarbon odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
59 F (15 C) (closed cup)	810 F (432 C)	Volume %	1.0	6.7

Extinguishing media: Carbon dioxide, dry chemical or "alcohol" foam. A water spray may be ineffective to put out fire, but may be used to cool fire-exposed containers. A stream of water can spread fire of burning liquid. This is a flammable liquid (OSHA Class IB) which can readily form explosive mixtures with air, especially when heated. Heavier-than-air vapors can flow along surfaces to reach distant ignition sources, and then flash back. Firefighters should use self-contained breathing equipment and eye protection to fight fires in enclosed places.

SECTION V. REACTIVITY DATA

This material is stable in storage in closed containers at room temperature. It does not polymerize.

This flammable material should be kept separated from oxidizing agents, strong acids and bases and ammonia. Thermal-oxidative degradation can produce toxic products, including carbon monoxide.

SECTION VI. HEALTH HAZARD INFORMATION	TLV 100 ppm
<p>Excessive exposure to vapors will irritate the eyes and mucous membranes of the upper respiratory tract. Sustained high levels can produce headache, depression of the central nervous system, narcosis and coma.</p> <p>Liquid contact is irritating to the eyes and irritation and defatting to the skin, leading to dermatitis on prolonged or repeated exposures. Ingestion may lead to aspiration of liquid into the lungs. Small amounts of aspirated ethyl benzene cause extensive edema and hemorrhage of lung tissue. FIRST AID:</p> <p>Eye contact: Wash eyes well with plenty of running water. Get medical help if irritation persists.</p> <p>Skin contact: Wash exposed areas of skin. Promptly remove contaminated clothing.</p> <p>Inhalation: Remove victim to fresh air. Restore breathing if necessary. Get medical help for serious exposure.</p> <p>Ingestion: Get prompt medical help! (The danger of aspirating ethyl benzene into the lungs indicates medical direction before inducing vomiting.)</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Personnel involved in leak or spill control and clean-up must use protective equipment to avoid inhalation of vapors and contact with liquid. Eliminate ignition sources. Provide maximum explosion-proof ventilation.</p> <p>Pick-up spilled material for recovery or disposal. Absorb with sand, etc. for disposal in a sanitary landfill or with paper towels or cloths for burning. Water can be used to flush liquid away from sensitive areas to special catch basins or ground, but not to sewer or surface water.</p> <p>DISPOSAL: Scrap material can be burned in approved incinerators in accordance with Federal, State and local regulations.</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Provide explosion-proof general and local exhaust ventilation to meet TLV requirements. Approved respirators must be available for non-routine or emergency use. A full face respirator with organic vapor cartridge can be used up to 1000 ppm; a gas mask with organic vapor canister can be used up to 5000 ppm. A self-contained respirator is needed for high and unknown concentrations of vapor.</p> <p>Use impervious gloves and clothing and a face shield to prevent repeated or prolonged contact with the liquid. Where splashing is possible chemical goggles should be used. Clothing contaminated with ethyl benzene should be promptly removed and not reused until free of the contaminant.</p> <p>Exposures above the action level, liquid contact, or working where fire and explosion hazards exist may require instituting employee training, medical surveillance, vapor concentration monitoring, record keeping, etc. when the proposed standard issues.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Store this material in tightly closed containers in cool, well-ventilated areas, away from oxidizing agents, heat and sources of ignition. Use non-sparking tools around this material. Containers must be electrically bonded and grounded for transfers of liquid. Use safety cans for small amounts. No Smoking! where this material is stored or used.</p> <p>Screen workers for history of kidney, liver, skin and lung problems which could give increased sensitivity and risk in ethyl benzene exposure.</p> <p>Avoid breathing of vapors and contact with liquid. Do not ingest. Chronic properties are not fully known; use with care.</p>	
DATA SOURCE(S) CODE: 2-9, 11, 12	<p>APPROVALS: MIS, <i>J. H. Wilson</i> CRD</p> <p>Industrial Hygiene and Safety <i>DeWitt</i></p> <p>Corporate Medical Staff <i>J. F. Martin MD</i></p>
<p>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</p>	

COMPOUND NO. 15

FLUORANTHENE

CHEMICAL NAME: FLUORANTHENE

FORMULA: C16H10

SYNONYMS

BENZOFLUORENE

IDRYL

1,2-(1,8-NAPHTHYLENE) BENZENE

1,2-BENZACENAPHTHENE

BENZENE, 1,2-(1,8-NAPHTHYLENE)-

BENZO(JK)FLUORENE

8,9-BENZOFLUORANTHENE

OHS09910

PERMISSIBLE EXPOSURE LIMIT

NONE ESTABLISHED

INDEFINITE ANIMAL CARCINOGEN (RTEC)

MUTAGENIC DATA (RTEC)

CERCLA HAZARD RATINGS - TOXICITY 1 - IGNITABILITY 0 - REACTIVITY 0 -
PERSISTENCE 3

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONCENTRATION: NONE SPECIFIED

PHYSICAL DESCRIPTION

COLORLESS SOLID, NEEDLES

CHEMICAL AND PHYSICAL PROPERTIES

MOLECULAR WEIGHT: 202.26

BOILING POINT AT 1 ATM, F: 707 F

SOLUBILITY IN WATER, G/100 G WATER AT 20C: INSOLUBLE

FLASH POINT, CLOSED CUP, F (OR OPEN CUP IF OC): 225 F

VAPOR PRESSURE @ 20 C, MMHG: 0.01 MM HG

MELTING POINT, F: 248 F

UPPER EXPLOSIVE LIMIT IN AIR, % BY VOLUME: COMBUSTIBLE

LOWER EXPLOSIVE LIMIT IN AIR, % BY VOLUME: COMBUSTIBLE

SPECIFIC GRAVITY: 1.252 AT 32 F

INCOMPATIBILITIES: HEAT

PERSONAL PROTECTIVE EQUIPMENT

USE APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT NECESSARY TO PREVENT
REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

EMPLOYERS SHALL ENSURE THAT CLOTHING CONTAMINATED WITH THIS SUBSTANCE
IS PLACED IN CLOSED CONTAINERS FOR STORAGE UNTIL IT CAN BE DISCARDED OR
UNTIL THE EMPLOYER PROVIDES FOR THE REMOVAL OF THE CONTAMINANT FROM THE
CLOTHING. IF THE CLOTHING IS TO BE LAUNDERED OR OTHERWISE CLEANED TO
REMOVE THE CONTAMINANT, THE EMPLOYER SHALL INFORM THE PERSON PERFORMING
THE CLEANING OF THE HAZARDOUS PROPERTIES OF THE SUBSTANCE.

GOGGLES

USE DUST-RESISTANT SAFETY GOGGLES WHERE THIS
SOLID MAY CONTACT THE EYES.

WASHING CHEMICALS FROM THE SKIN

EMPLOYERS SHALL ENSURE THAT EMPLOYEES WHOSE SKIN BECOMES CONTAMINATED
WITH THIS SUBSTANCE PROMPTLY WASH OR SHOWER WITH SOAP OR MILD DETERGENT
AND WATER TO REMOVE ANY CONTAMINANT FROM THE SKIN.

WASH HANDS THOROUGHLY WITH SOAP OR MILD DETERGENT AND WATER BEFORE EATING, SMOKING, OR USING TOILET FACILITIES.

ROUTINE CHANGING OF WORK CLOTHING

EMPLOYERS SHALL ENSURE THAT EMPLOYEES WHOSE CLOTHING MAY HAVE BECOME CONTAMINATED WITH THIS SUBSTANCE CHANGE INTO UNCONTAMINATED CLOTHING BEFORE LEAVING THE WORK PREMISES.

CLOTHING REMOVAL FOLLOWING ACCIDENTAL CONTAMINATION

EMPLOYERS SHALL ENSURE THAT NON-IMPERVIOUS CLOTHING WHICH BECOMES CONTAMINATED WITH THIS SUBSTANCE BE REMOVED PROMPTLY AND NOT REWORN UNTIL THE SUBSTANCE IS REMOVED FROM THE CLOTHING.

SPECIFIC EMERGENCY PROVISIONS: NONE REQUIRED

RESPIRATOR SELECTION (UPPER LIMIT DEVICES PERMITTED)

NO SPEC ADVISE

- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE

HIGH LEVELS

- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE, HELMET, OR HOOD

FIREFIGHTING

- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE

ROUTE OF ENTRY INTO BODY

INHALATION

INGESTION

SYMPTOMS

GASTROINTESTINAL IRRITATION

NAUSEA

MUCOUS MEMBRANE IRRITATION

VOMITING

ABDOMINAL IRRITATION

FIRST AID PROCEDURES FOLLOWING EXPOSURE

IF A PERSON BREATHES IN LARGE AMOUNTS OF THIS CHEMICAL, MOVE THE EXPOSED PERSON TO FRESH AIR AT ONCE. IF BREATHING HAS STOPPED PERFORM ARTIFICIAL RESPIRATION. KEEP THE AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION AS SOON AS POSSIBLE.

ORGANS

GASTROINTESTINAL

MUCOUS MEMBRANES

CAS NUMBER: 206-44-0

REGISTRY TOXIC CHEMICALS NUMBER: LL4025000

SPECIAL INFORMATION: POTENT CO-CARCINOGEN.

COMPOUND NO. 16

LEAD



J. T. Baker Chemical Co.

222 Red School Lane Phillipsburg, N.J. 08865
24-Hour Emergency Telephone -- (201) 859-2151

Chemtrec # (800) 424-9300
National Response Center # (800) 424-8802

MATERIAL SAFETY DATA SHEET

L2352 -01
Effective: 11/20/85

Lead, 1000 ppm (0.100% w/o)

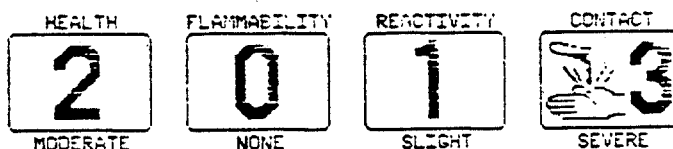
Page: 1
Issued: 11/20/85

SECTION I - PRODUCT IDENTIFICATION

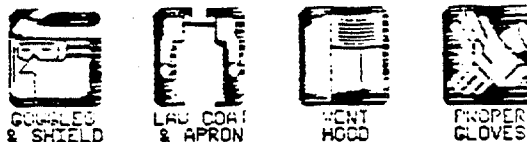
Product Name: Lead, 1000 ppm (0.100% w/o)
Formula: Pb_3O_4 in HNO_3
Formula Wt: 207.20
CAS No.: 00000-00-0
Product Codes: 6930

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA™ System



Laboratory Protective Equipment



Precautionary Label Statements

DANGER!
CAUSES BURNS
HARMFUL IF SWALLOWED

Do not get in eyes, on skin, on clothing.
Avoid breathing vapor. Keep in tightly closed container. Use with adequate ventilation. Wash thoroughly after handling.

SECTION II - HAZARDOUS COMPONENTS

Component	%	CAS No.
Lead Oxide	0-1	1314-41-6
Nitric Acid	1-2	7697-37-2

SECTION III - PHYSICAL DATA

Boiling Point: 100°C (212°F) Vapor Pressure(mmHg): N/A
Melting Point: 0°C (32°F) Vapor Density(air=1): N/A

Continued on Page: 2



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MATERIAL SAFETY DATA SHEET

L2352 -01

Lead, 1000 ppm (0.100% w/w)

Page: 2

Effective: 11/20/85

Issued: 11/20/85

SECTION III - PHYSICAL DATA (Continued)

Specific Gravity: 1.00
(H₂O=1)

Evaporation Rate: N/A
(Butyl Acetate=1)

Solubility(H₂O): Complete (in all proportions) & Volatiles by Volume: N/A

Appearance & Odor: Clear, colorless solution.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A NFPA 704M Rating: 3-0-0

Fire Extinguishing Media

Use extinguishing media appropriate for surrounding fire.

Special Fire-Fighting Procedures

Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece operated in positive pressure mode.

1. Gases Produced

nitrogen oxides

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value (TLV/TWA): 0.15 mg/m³ (ppm)

Toxicity: LD₅₀ (ipr-rat)(mg/kg) - 630

Effects of Overexposure

Liquid may cause burns to skin and eyes.
Vapors may be irritating to eyes, nose and throat.
Inhalation of vapors may cause coughing and difficult breathing.
Chronic effects resulting from low level exposure to lead compounds may include anemia, kidney damage, impaired eyesight, and lead build-up in the central nervous system (particularly the brain).

Emergency and First Aid Procedures

CALL A PHYSICIAN.

If swallowed, do NOT induce vomiting; if conscious, give water, milk, or milk of magnesia.

In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.

Wash clothing before re-use.

Toxicity test results are listed for the solute.



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MATERIAL SAFETY DATA SHEET

L2352 -01
Effective: 11/20/85

Lead, 1000 ppm (0.100% w/o)

Page: 3
Issued: 11/20/85

SECTION VI - REACTIVITY DATA

Stability: Stable

Hazardous Polymerization: Will not occur

Conditions to Avoid: none documented

Incompatibles: strong reducing agents

Decomposition Products: oxides of nitrogen

SECTION VII - SPILL AND DISPOSAL PROCEDURES

Steps to be taken in the event of a spill or discharge

Wear self-contained breathing apparatus and full protective clothing.
Stop leak if you can do so without risk. Use water spray to reduce vapors.
Take up with sand or other non-combustible absorbent material and place
into container for later disposal. Flush spill area with water.

Disposal Procedure

Dispose in accordance with all applicable federal, state, and local
environmental regulations.

EPA Hazardous Waste Number: D002 (Corrosive Waste)

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

Eye/Skin Protection: This is a laboratory-use product for which no
industrial protective equipment has been
designated.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATATM Storage Color Code: White

Special Precautions

Keep container tightly closed. Store in corrosion-proof area.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

Proper Shipping Name	Nitric acid, 40% or less solution
Hazard Class	Corrosive material (liquid)
UN/NA	NA1760
Labels	CORROSIVE
Reportable Quantity	1000 LBS.



J. T. Baker Chemical Co.

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MATERIAL SAFETY DATA SHEET

L2352 -01

Lead, 1000 ppm (0.100% w/v)

Page: 4

Effective: 11/20/85

Issued: 11/20/85

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION (Continued)

INTERNATIONAL (I.M.O.)

Proper Shipping Name	Nitric acid, solution
Hazard Class	8
UN/NA	UN2031
Labels	CORROSIVE

NA = Not Applicable or Not Available

The information published in this Material Safety Data Sheet has been compiled from our experience and data presented in various technical publications. It is the user's responsibility to determine the suitability of this information for the adoption of necessary safety precautions. We reserve the right to revise Material Safety Data Sheets periodically as new information becomes available.

COMPOUND NO. 17

MERCURY

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 26

MERCURY

Revision B

Date September 1981

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: MERCURY
DESCRIPTION: A liquid, metallic element.
OTHER DESIGNATIONS: Quick Silver, GE Material B21Y4, CAS #007 439 976, Hg, Hydrargyrum
MANUFACTURER: Available from many sources.

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Mercury	~100	8-hr TWA 0.05 mg/m ³ * Women, Inhalation TDLo 150 ug/m ³ /46D TFX: GI, CNS. Human, Oral LDLo 1429 mg/kg
*ACGIH (1981) TLV. Current OSHA standard is 0.1 mg/m ³ ceiling level.		

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C --	356.6	Specific gravity (H ₂ O=1) -----	13.5
Vapor press. at 20 C, mm Hg ----	0.0012	Melting point, deg C -----	-38.9
at 126 C, mm Hg ----	1	Atomic weight -----	200.61
Water solubility -----	nil	Atomic number -----	80

Appearance & Odor: A silvery, dense mobile liquid, no odor. (Vapor has no warning properties).

SECTION IV. FIRE AND EXPLOSION DATA

	Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
	Noncombustible				

Extinguishing Media: Select extinguishing media suitable for surrounding fire. Mercury is nonflammable and nonexplosive in air. When exposed to high temperature, mercury vaporizes to form extremely toxic fumes. When this material is involved in a fire, firefighters need to use self-contained breathing apparatus.

SECTION V. REACTIVITY DATA

Mercury is a stable metallic element. It will react slowly with oxygen when heated, and it reacts with halogens; for example, at 200-300 C a flame forms when a jet of chlorine gas is directed over mercury. Mercury dissolves (reacts) in oxidizing acids, such as nitric; but it does not dissolve in hydrochloric acid. Boron phosphodiiodide will ignite in mercury vapor. The following can give explosive mixtures with mercury: acetylene, ammonia, chlorine dioxide, nitric acid plus ethanol, and methyl azide.

SECTION VI. HEALTH HAZARD INFORMATION

TLV 0.05 mg/m³ (See Sect II).

Elemental Hg, liquid and vapor, is toxic due to its liquid solubility, lack of charge, and membrane permeability. Inhaled vapors (80%) diffuse rapidly through alveolar membranes into the blood and are systemically transported to body tissues, including the brain. Exposure to high conc. (>1.2 mg/m³) of vapors for brief periods can cause pneumonitis, chest pains, dyspnea, coughing; later stomatitis, gingivitis, and salivation occur. Hg can be absorbed slowly through the skin. Chronic symptoms involve the CNS with tremors and various neuropsychiatric disturbances. The TLV would be exceeded if the contents of a small Hg clinical thermometer were dispersed in a closed 100' x 100' x 15' room. GI uptake of Hg is low (<5%).

FIRST AID:

Eye Contact: Flush with running water for 15 min. including under the eyelids.

Skin Contact: Remove contaminated clothing. Wash affected area with soap and water.

Inhalation: Remove to fresh air. Restore and/or support breathing as needed. Administer O₂ for chem. pneumonitis.

Ingestion: Gastric lavage with 5% solution of sodium formaldehyde sulfoxylate, followed by 2% NaHCO₃, and finally leave 250 cc of the sodium formaldehyde sulfoxylate in the stomach.

Seek medical assistance for further treatment, observation and support.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Provide adequate ventilation. Clean-up spills promptly. A suction bottle with a capillary tube for small amounts can be used. Vacuum cleaners may be used provided they have special mercury absorbent exhaust filters. Calcium polysulfide with excess sulfur can be sprinkled into cracks or other inaccessible places to convert mercury globules into the sulfide. Collect picked-up or scrapped mercury in tightly sealed containers for reclaim or for disposal. Do not discharge mercury down the drain!

DISPOSAL: Mercury should be salvaged for purification. Sell to a salvage company when large amounts are involved. Follow Federal, State, and local regulations.

EPA Hazardous Waste Number under RCRA is U151. 40CFR261.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide adequate exhaust ventilation to meet TLV requirements in the workplace. Operations requiring an exposed Hg surface should reduce the temp. of Hg to limit vaporization and minimize vapor exposure by using a local exhaust.

Self-contained breathing apparatus can be used up to 5 mg/m³ with a full facepiece above 1 mg/m³. Positive pressure-type air supplied breathing equipment has been recommended above 5 mg/m³.

Avoid eye contact by use of chemical safety glasses. Wear rubber gloves and protective clothing appropriate for the work situation. Separate work and street clothing. Store work clothing in special lockers. Showers to be taken before changing to street clothes. Provide preplacement and periodic medical exams for those regularly exposed to Hg, with emphasis directed to CNS, skin, lungs, liver, kidneys and G.I. tract.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed unbreakable containers (polyethylene) in a cool, dry, well-ventilated area away from sources of heat. Protect containers from physical damage.

Mercury evaporates very slowly. Spilled Hg forms many tiny globules that will evaporate faster than a single pool and can develop a significant concentration of vapors in an unventilated area. Such vapors can be poisonous, especially if breathed over a long period of time. Heated Hg evolves high levels of toxic vapors.

Avoid direct contact with mercury. Follow good hygienic and housekeeping practices. Construction of work area floors and counter surfaces to be smooth, nonporous. No eating or smoking in work areas.

DOT Classification: ORM-B

DATA SOURCE(S) CODE: 2-12,16,31,37-40,44

APPROVALS: MIS
CRD

Industrial Hygiene
and Safety

MEDICAL REVIEW: 21 October 1981

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COMPOUND NO. 18

METHYLENE CHLORIDE

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION

1145 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854



MSDS # 310

METHYLENE CHLORIDE
Revision E

Issued:

Revised: September, 1985

From Genium's MSDS Collection, to be used as a reference.

SECTION 1. MATERIAL IDENTIFICATION			17	
MATERIAL NAME: METHYLENE CHLORIDE (Revision E) OTHER DESIGNATIONS: Dichloromethane, FREON 30, Methane Dichloride, CH ₂ Cl ₂ ; CAS#75-09-2. MANUFACTURER/SUPPLIER: Available from many suppliers, including: Dow Chemical USA 2020 Dow Center Midland, MI 48640 (517) 636-1000				
SECTION 2. INGREDIENTS AND HAZARDS			%	HAZARD DATA
METHYLENE CHLORIDE <div style="text-align: center;">$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{Cl} \\ \\ \text{Cl} \end{array}$</div> <p>* ACGIH TLV/TWA (1985-86). OSHA PEL is 500 ppm with a ceiling of 1000 and a permissible peak exposure of 2000 ppm for 5 minutes per any two-hour period.</p> <p>NIOSH recommends a 10 hr. TWA or 75 ppm with a ceiling concentration of 500 ppm (15 minute TWA). NIOSH also warns that toxic hazards associated with exposure to methylene chloride are increased by the presence of alcohol and/or carbon monoxide and by heavy labor and smoking.</p>			ca 100	8 hr TWA: 100 ppm or 350 mg/m ³ * ----- Human, Inhalation: TCLo: 500 ppm/8 hr. (Blood effects) ----- TCLo: 500 ppm/ 1 year-I (CNS effects) ----- Rat, Oral: LD50: 2000 mg/kg
SECTION 3. PHYSICAL DATA				
Boiling point, 1 atm 104°F (40°C) Specific gravity, 25/25C 1.32 Vapor pressure @ 20°C, mmHg 340 Volatiles, % ca 100 Vapor density (Air=1) 2.9 Evaporation rate (CCl ₄ =1) ... 1.47 Solubility in water, wt. % @ 20°C ... ~1.6 Freezing point -140.8°F (-96°C) Molecular weight 84.94				
APPEARANCE & ODOR: Colorless liquid with a penetrating ether-like, sweetish odor. The unfatigued recognition threshold for 100% of test panel is 214 ppm.				
SECTION 4. FIRE AND EXPLOSION DATA			Lower	Upper
Flash Point and Method	Autoignition Temp.	Flammability Limits in Air		
None (T.C.C.)	1031°F (555°C)	Vol % at 100°C in O ₂	12	66.4
EXTINGUISHING MEDIA: Use extinguishing media that are appropriate for the surrounding fire. Use water spray to cool fire-exposed tanks/containers. When heated, methylene chloride forms weakly combustible mixtures in air. It will form flammable and explosive mixtures in an oxygen-enriched atmosphere. Methylene chloride has a high vapor pressure; when spilled, its vapor concentration in air may increase rapidly. Containers of methylene chloride may rupture violently during a fire. . Firefighters should wear self-contained breathing apparatus with face piece and full protective clothing. Vapors of methylene chloride can flow to low-lying areas.				
SECTION 5. REACTIVITY DATA				
This material is stable at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization. Methylene chloride is incompatible with alkali metals including sodium-potassium alloy, finely powdered aluminum and magnesium, n-Methyl-n-nitroso-urea, and potassium hydroxide, and potassium tert-butoxide. Contact with these materials may cause violent reaction or explosion. Prolonged exposure to water may cause noticeable hydrolysis to highly corrosive hydrochloric acid when temperature is above 60°C. Avoid contact with oxidizing agents and caustics. In organic-enriched atmospheres or when heated (>100°C) vapors may be readily ignited. Exposure to high temperatures (from open flames, hot surfaces, welding arcs, etc.) can produce corrosive and toxic thermal oxidative decomposition products such as hydrogen chloride and small quantities of phosgene.				

SECTION 6. HEALTH HAZARD INFORMATION

TLV 100 ppm (see Section 2)

Methylene Chloride enters the body mainly by inhalation and skin absorption. Vapors of methylene chloride are narcotic and may cause toxic encephalopathy. Excessive inhalation of vapor (300-700 ppm for 3-5 hrs.) causes slight loss of coordination and equilibrium. Symptoms of overexposure can also include dizziness, nausea, tingling of extremities, stupor, lethargy, convulsions and diminished vision. Severe exposures may cause unconsciousness and death. Symptoms of overexposure to methylene chloride are usually delayed in onset. The liquid is irritating to the eyes and may cause burns if not promptly removed. Prolonged or repeated contact with the skin may cause redness, irritation, dermatitis, frostbite or burns. It may be absorbed through the skin in toxic amounts. Ingestion of methylene chloride causes irritation of the gastrointestinal tract and symptoms resembling those from inhalation of vapor. Long-term exposure to mild or moderate doses of methylene chloride may cause delayed onset (24-48 hrs.) of dizziness, headache, mental confusion, slurred speech, double vision and sleeplessness. Medical recovery may be slow. NOTE: Methylene chloride is stored in body fat and metabolizes to carbon monoxide, which increases and sustains carboxyhemoglobin levels in the blood, reducing its oxygen-carrying capacity. It may damage the liver, kidneys, or blood. Alert medical attendants to its secondary hazard.

FIRST AID: EYE CONTACT: Promptly flush eyes, including under eyelids, with running water for at least 15 minutes. Get medical attention if irritation persists (in-plant, paramedic, or community). SKIN CONTACT: Flush exposed area with water while removing contaminated clothing. Get medical attention if irritation persists. INHALATION: Remove to fresh air. Restore and/or support breathing (O₂ therapy) as required. Keep warm and at rest. Get medical help. Advise physician not to use adrenalin. INGESTION: Get prompt medical help! Do not induce vomiting. If vomiting occurs spontaneously, position victim's head below trunk to resist aspiration hazard. Advise physician not to use adrenalin.

SECTION 7. SPILL, LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of large spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Evacuate all personnel from the area except for those involved in clean-up. Remove leaking container to safe place if feasible. Absorb small spills with an absorbent material such as paper towel or vermiculite. Evaporate off solvent in an exhaust hood and place absorbent in a closed container for disposal. Dike large spills and collect for recovery or disposal. Pick up residue with absorbent (as with small spills) or flush to ground (not to sewer) to evaporate. Clean-up personnel should wear respiratory equipment and protective clothing to prevent inhalation of vapor and contact with skin/eyes. DISPOSAL: Reclaim waste solvent by filtration and distillation procedures. Place in closed containers for disposal by a licensed contractor, or burn in an approved incinerator.

Methylene chloride is designated as a hazardous waste by the EPA. The EPA (RCRA) H.W. No. is 080 (40CFR261).

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation (explosion-proof) to meet TLV requirements. Floor level ventilation and sump ventilation may also be necessary. For emergency or non-routine exposures, wear an appropriate NIOSH-approved respirator. All electrical service in use or storage areas should have an explosion-proof design. When handling liquid, wear neoprene, PVA, or vitron gloves and safety glasses. In case of leak or spill or unusual handling where repeated or prolonged contact may occur, use protective clothing, apron, boots, and splash goggles or face shield as necessary. Remove contaminated clothing promptly and do not reuse until it has been properly laundered. Eye wash stations and safety showers should be readily available in use and handling areas. Contact lenses pose a special hazard; soft lenses absorb; all lenses concentrate irritants. NOTE: CO and CH₂Cl₂ content of workplace air are additive and both must be monitored where methylene chloride exposures occur. Preplacement and annual physical exams should emphasize the nervous and respiratory systems liver, kidneys, skin, eyes and carboxyhemoglobin levels. Those with a history of cardiovascular disease or who are heavy drinkers or smokers should avoid exposure to this material.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from combustibles and sources of heat and ignition. Open containers slowly and with caution. Protect containers from physical damage. Keep containers and storage tanks free of water and moist air. Be careful when handling this compound. Use only with adequate ventilation. Don't breathe vapors. Avoid contact with eyes, skin and clothing. When methylene chloride vapors are drawn into the combustion chamber of a space heater, severe corrosion damage to the heater can occur, even at levels well below the TLV. LARC Review (1979) listed animal carcinogenic determination as indefinite. A substantial risk notice to EPA (TSCA, 8e) reports a high incidence of lung and liver tumors in mice in long-term inhalation studies at 2000-4000 ppm (1984, preliminary).

DOT CLASSIFICATION: ORM-A **DOT I.D. No.** UN1593 **LABEL:** None (or St. Andrew's Cross)

IMO CLASS: 6.1

DATA SOURCE(S) CODE (See Glossary) 1-12, 14, 16, 23, 25, 31, 34, 37, 38, 47, 48.R.

Judgements as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.

APPROVALS

INDUST. HYGIENE/SAFETY

MEDICAL REVIEW:

COMPOUND NO. 19

NAPHTHALENE

CHEMICAL NAME: NAPHTHALENE

FORMULA: C10H8

SYNONYMS

WHITE TAR
NAPTHALEN
NAPHTHENE
NCI-C52904
MOTH BALLS
NAPHTHALENE, MOLTEN
UN 2304
UN 1334

CAMPBOR TAR
MOTH FLAKES
NAPHTHALIN
NAPHTHALINE
TAR CAMPBOR
ALBOCARBON
DEZODORATOR
OHS16120

PERMISSIBLE EXPOSURE LIMIT

10 PPM OSHA TWA
10 PPM ACGIH TWA
15 PPM ACGIH STEL
EXPERIMENTAL CARCINOGEN (NTP)
CERCLA HAZARD RATINGS - TOXICITY 2 - IGNITABILITY 2 - REACTIVITY 0 -
PERSISTENCE 3

TOXICOLOGY: NAPHTHALENE IS A SKIN SENSITIZER AND HEMOLYTIC AGENT.

ACUTE EXPOSURE CAUSES HEMOLYSIS, LIVER AND KIDNEY DAMAGE, JAUNDICE, OLIGURIA, AND CONVULSIONS. THE SUSCEPTIBILITY TO HEMOLYTIC EFFECTS OCCURS IN INDIVIDUALS WITH A HEREDITARY DEFICIENCY OF GLUCOSE-6-PHOSPHATE DEHYDROGENASE IN THE RED BLOOD CELLS. ACUTE INHALATION OF NAPHTHALENE VAPORS CAUSES IRRITATION AND CENTRAL NERVOUS SYSTEM EFFECTS.

CHRONIC TOXICITY IS THE SAME AS ACUTE POISONING. REPEATED SKIN CONTACT PRODUCES ERYTHEMA AND DERMATITIS FROM PRIMARY IRRITATION OR ALLERGIC HYPERSENSITIVITY. EYE CONTACT RESULTS IN IRRITATION, INJURY, AND AT HIGH CONCENTRATIONS, LENS OPACITY. OPTIC NEURITIS HAS BEEN OBSERVED.

NAPHTHALENE IS NOT SUFFICIENTLY VOLATILE UNDER NORMAL CONDITIONS TO RESULT IN DANGEROUS VAPOR CONCENTRATIONS.

NAPHTHALENE ODOR, DETECTABLE AT LEVELS BELOW THE PEL, PROVIDES WARNING TO PREVENT SYSTEMIC TOXICITY AND IRRITATION.

THE THRESHOLD LIMIT VALUE WAS SET TO PREVENT EYE IRRITATION.

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONCENTRATION

500 PPM
OSHA/NIOSH

PHYSICAL DESCRIPTION

WHITE CRYSTALLINE, VOLATILE FLAKES; STRONG COAL-TAR ODOR.

CHEMICAL AND PHYSICAL PROPERTIES

MOLECULAR WEIGHT: 128
BOILING POINT AT 1 ATM, F: 424 F
SOLUBILITY IN WATER, G/100 G WATER AT 20C: 0.003 G
FLASH POINT, CLOSED CUP, F (OR OPEN CUP IF OC): 174 F
VAPOR PRESSURE @ 20 C, MMHG: 0.05 MM
MELTING POINT, F: 177 F
UPPER EXPLOSIVE LIMIT IN AIR, % BY VOLUME: 5.9%
LOWER EXPLOSIVE LIMIT IN AIR, % BY VOLUME: 0.9%
AUTOIGNITION TEMPERATURE: 979 F
SPECIFIC GRAVITY: 0.9625 AT 212 F
VAPOR DENSITY (AIR=1): 4.4
ODOR THRESHOLD: 0.3 PPM

INCOMPATIBILITIES
STRONG OXIDIZERS
CHROMIC ANHYDRIDE

PERSONAL PROTECTIVE EQUIPMENT

USE APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT NECESSARY TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

EMPLOYERS SHALL ENSURE THAT CLOTHING CONTAMINATED WITH THIS SUBSTANCE IS PLACED IN CLOSED CONTAINERS FOR STORAGE UNTIL IT CAN BE DISCARDED OR UNTIL THE EMPLOYER PROVIDES FOR THE REMOVAL OF THE CONTAMINANT FROM THE CLOTHING. IF THE CLOTHING IS TO BE LAUNDERED OR OTHERWISE CLEANED TO REMOVE THE CONTAMINANT, THE EMPLOYER SHALL INFORM THE PERSON PERFORMING THE CLEANING OF THE HAZARDOUS PROPERTIES OF THE SUBSTANCE.

GOGGLES

USE DUST-RESISTANT SAFETY GOGGLES WHERE THIS SOLID MAY CONTACT THE EYES.

WASHING CHEMICALS FROM THE SKIN

EMPLOYERS SHALL ENSURE THAT EMPLOYEES WHOSE SKIN BECOMES CONTAMINATED WITH THIS SUBSTANCE PROMPTLY WASH OR SHOWER WITH SOAP OR MILD DETERGENT AND WATER TO REMOVE ANY CONTAMINANT FROM THE SKIN.

EMPLOYERS SHALL ENSURE THAT EMPLOYEES WHO HANDLE THIS SUBSTANCE WASH THEIR HANDS THOROUGHLY WITH SOAP OR MILD DETERGENT AND WATER BEFORE EATING, SMOKING, OR USING TOILET FACILITIES.

ROUTINE CHANGING OF WORK CLOTHING

FOLLOWING INFORMATION FROM NIOSH/OSHA "OCCUPATIONAL HEALTH GUIDELINES FOR CHEMICAL HAZARDS":

EMPLOYERS SHALL ENSURE THAT EMPLOYEES WHOSE CLOTHING MAY HAVE BECOME CONTAMINATED WITH THIS SUBSTANCE CHANGE INTO UNCONTAMINATED CLOTHING BEFORE LEAVING THE WORK PREMISES.

CLOTHING REMOVAL FOLLOWING ACCIDENTAL CONTAMINATION

EMPLOYERS SHALL ENSURE THAT NON-IMPERVIOUS CLOTHING WHICH BECOMES CONTAMINATED WITH THIS SUBSTANCE BE REMOVED PROMPTLY AND NOT REWORN UNTIL THE SUBSTANCE IS REMOVED FROM THE CLOTHING.

SPECIFIC EMERGENCY PROVISIONS

DO NOT EAT OR SMOKE IN AREAS WHERE THIS SUBSTANCE IS HANDLED, PROCESSED OR STORED.

RESPIRATOR SELECTION (UPPER LIMIT DEVICES PERMITTED)

500 PPM

- CHEMICAL CARTRIDGE RESPIRATOR
WITH AN ORGANIC VAPOR CARTRIDGE
WITH A DUST FILTER
- GAS MASK
WITH AN ORGANIC VAPOR CANISTER
WITH A DUST FILTER
- SELF-CONTAINED BREATHING APPARATUS
WITH A FULL FACE-PIECE
- SUPPLIED-AIR RESPIRATOR
WITH A FULL FACE-PIECE, HELMET, OR HOOD

ESCAPE

- GAS MASK
WITH AN ORGANIC VAPOR CANISTER
WITH A HIGH-EFFICIENCY PARTICULATE FILTER
- SELF-CONTAINED BREATHING APPARATUS

FIREFIGHTING

- SELF-CONTAINED BREATHING APPARATUS
WITH A FULL FACE-PIECE
OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE

ROUTE OF ENTRY INTO BODY

INHALATION
SKIN ABSORPTION

INGESTION
SKIN OR EYE CONTACT

SYMPTOMS

EYE IRRITATION
HEADACHE
CONFUSION
MALAISE
NAUSEA
VOMITING
ABDOMINAL CRAMPS
SWEATING
JAUNDICE
HEMATURIA
HEMOGLOBINURIA
DERMATITIS
DIARRHEA
HEMOLYTIC ANEMIA
ITCH
ERYTHEMA
CENTRAL NERVOUS SYSTEM DEPRESSION
CORNEAL DAMAGE
HEPATIC NECROSIS
LIVER DAMAGE
EXCITATION

VISUAL DISTURBANCE
OLIGURIA
ANURIA
CONVULSIONS
PROTEINURIA
COMATOSE
KIDNEY DAMAGE
RESPIRATORY FAILURE
OPTIC NEURITIS
REPRODUCTIVE EFFECTS IN EXPERIMENTAL
ANIMALS
INCREASED TENDON REFLEXES
ABDOMINAL PAIN
ALBUMINURIA
MYXEDEMA
CONJUNCTIVITIS
DYSURIA
HEPATOMEGALY
OPTIC NEURITIS
HYPERCALCEMIA

FIRST AID PROCEDURES FOLLOWING EXPOSURE

IF THIS CHEMICAL GETS INTO THE EYES, IMMEDIATELY WASH THE EYES WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE LOWER AND UPPER LIDS. GET MEDICAL ATTENTION IMMEDIATELY. CONTACT LENSES SHOULD NOT BE WORN WHEN WORKING WITH THIS CHEMICAL.

IF THIS CHEMICAL GETS ON THE SKIN, IMMEDIATELY WASH CONTAMINATED SKIN WITH SOAP OR MILD DETERGENT & WATER. IF THIS CHEMICAL SOAKS CLOTHING, IMMEDIATELY REMOVE CLOTHING & WASH SKIN WITH SOAP OR MILD DETERGENT & WATER. GET MEDICAL ATTENTION PROMPTLY.

IF A PERSON BREATHEES IN LARGE AMOUNTS OF THIS CHEMICAL, MOVE THE EXPOSED PERSON TO FRESH AIR AT ONCE. IF BREATHING HAS STOPPED PERFORM ARTIFICIAL RESPIRATION. KEEP THE AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION AS SOON AS POSSIBLE.

NAPHTHALENE INGESTION:

EMERGENCY TREATMENT - REMOVE BY GASTRIC LAVAGE OR EMESIS.
TREAT CONVULSIONS.

ORGANS

EYES
BLOOD
LIVER
KIDNEYS

SKIN

RED BLOOD CELLS
CENTRAL NERVOUS SYSTEM

FOLLOWING INFORMATION FROM BUREAU OF EXPLOSIVES "EMERGENCY HANDLING OF HAZARDOUS MATERIALS":

IF MATERIAL ON FIRE OR INVOLVED IN FIRE:

- * EXTINGUISH FIRE USING AGENT SUITABLE FOR TYPE OF SURROUNDING FIRE (MATERIAL ITSELF DOES NOT BURN OR BURNS WITH DIFFICULTY)
- * USE WATER IN FLOODING QUANTITIES AS FOG
- * USE ALCOHOL FOAM OR CO2 OR DRY CHEMICAL EXTINGUISHERS

IF MATERIAL IS NOT ON FIRE AND IS NOT INVOLVED IN FIRE:

- * KEEP SPARKS, FLAMES AND OTHER IGNITION SOURCES AWAY
- * KEEP MATERIAL OUT OF WATER SOURCES AND SEWERS

PERSONNEL PROTECTION:

- * AVOID BREATHING DUST/VAPORS/FUMES FROM MATERIAL
- * KEEP UPWIND
- * AVOID BODILY CONTACT WITH MATERIAL
- * WEAR BOOTS, PROTECTIVE GLOVES AND GAS TIGHT GOGGLES
- * DO NOT HANDLE BROKEN PACKAGES WITHOUT PROTECTIVE EQUIPMENT
- * WASH AWAY ANY MATERIALS WHICH MAY HAVE CONTACTED THE BODY WITH COPIOUS AMOUNTS OF WATER OR SOAP AND WATER
- * WEAR SELF-CONTAINED BREATHING APPARATUS WHEN FIGHTING FIRES INVOLVING THIS MATERIAL
- * IF CONTACT WITH MATERIAL ANTICIPATED, WEAR FULL PROTECTIVE CLOTHING

FOLLOWING INFORMATION FROM DEPARTMENT OF TRANSPORTATION/U.S. COAST GUARD "CHEMICAL RESPONSE INFORMATION SYSTEM", REGARDING WATER SPILLS:

- * U.S. COAST GUARD REQUIRES 24 HOUR ADVANCE NOTICE TO CAPTAIN OF THE PORT WHEN THIS SUBSTANCE IS SCHEDULED TO ARRIVE AT PORT WHEN TRANSPORTED IN BULK QUANTITY
- * SUBSTANCE FLOATS ON WATER
- * RESTRICT ACCESS OF GENERAL PUBLIC WHEN APPRECIABLE DANGER ARISES FROM SPILL
- * SKIM SURFACE SLICK
- * USE MECHANICAL DREDGES OR LIFTS TO REMOVE IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES
- * HIGHLY VOLATILE, AVOID INHALATION, VAPORS OR DUST ARE IRRITATING OR TOXIC
- * HIGHLY CORROSIVE, AVOID DIRECT CONTACT, CONTACT WITH SKIN OR EYES CAN CAUSE IRRITATION OR BURNS
- * SORBS STRONGLY ON BOTTOM SEDIMENTS, SUBSTANCE IS NOT AT ALL SOLUBLE OR REACTIVE

LISTED BY U.S. COAST GUARD UNDER CARGO COMPATIBILITY GROUP AROMATIC HYDROCARBONS, INCOMPATIBLE WITH NITRIC ACID

CAS NUMBER: 91-20-3

REGISTRY TOXIC CHEMICALS NUMBER: QJ0525000

COMPOUND NO. 20

PERCHLOROETHYLENE

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 313

PERCHLOROETHYLENE

Revision C

Date November 1978

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: PERCHLOROETHYLENE

OTHER DESIGNATIONS: Perchloroethylene, Tetrachloroethylene, Ethylene Tetrachloride, $Cl_2C=CCl_2$, GE Material D5B84, CAS# 000 127 184

MANUFACTURER & TRADENAME: BLACO-PER (Baron-Blakeslee); PERCHLOR (PPG); PERK (Stauffer); PERCLEN (Diamond Shamrock)

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Perchloroethylene plus stabilizer*	ca 100	8-hr TWA 100 ppm** with 200 ppm Ceiling and 300 ppm 5 minute peak in any 3 hrs Rat, inhalation LCLo 4000 ppm/4 hrs
<p>*Stabilized material usually contains a small amount of amine and/or phenolic stabilizer. Stabilizers and levels used vary with the grade and the supplier.</p> <p>**Current OSHA levels. ACGIH TLV (1978) is 100 ppm (skin). In 1976 NIOSH proposed a 10-hr TWA of 50 ppm with a 100 ppm ceiling (15 minute sample). NIOSH (1978) has warned of possible carcinogenicity based on animal tests.</p>		

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F (C)	---- 250 (121)	Specific gravity 20/4°C	--- 1.623
Vapor pressure at 22 C, mm Hg	----- 15.8	Volatiles, %	----- ca 100
Vapor density (Air=1)	----- 5.83	Evaporation rate (CCl_4 =1)	-- 0.27
Water solubility	----- Negligible	Molecular weight	----- 165.83
<p>Appearance & Odor: Colorless liquid with pleasant ethereal odor whose recognition threshold (100% of test panel, unfatigued) is 4.68 ppm in air.</p>			

SECTION IV. FIRE AND EXPLOSION DATA

			LOWER	UPPER
Flash Point and Method	Autoignition Temp.	Flammability Limits In Air		
Not Combustible	None	N/A	N/A	N/A
<p>Extinguishing Media: Use that which is suitable for the surrounding fire. Although not combustible, perchloroethylene can be hazardous in a fire situation because of vapor generation and from thermo-oxidative degradation at high temperature to phosgene (highly toxic) and hydrogen chloride (corrosive). Firefighters should use self-contained breathing apparatus when this material is involved in a fire situation.</p>				

SECTION V. REACTIVITY DATA

Perchloroethylene is considered a stable compound under normal storage and handling conditions. However, vapor exposure to high temperature or electric arcs may cause decomposition to hydrogen chloride and phosgene (highly toxic). Avoid mixing with caustic soda or potash. Do not allow hydrochloric acid build-up to occur in degreasing tanks (stabilizer exhausted). Prolonged exposure to sunlight (UV) can degrade unstabilized material.

SECTION VI. HEALTH HAZARD INFORMATION	TLV 100 ppm (skin) (See Sect II)
<p>Perchloroethylene may cause dermatitis through prolonged or repeated skin contact with liquid and irritation, lachrymation, and burning sensation of the eyes by liquid or vapor contact. Loss of coordination, narcosis, tremors, abdominal cramps, irritation of the respiratory tract, and nausea may result from inhalation of excessive airborne concentrations. (600 ppm for 10 minutes may effect the central nervous system.) Very high exposures produce unconsciousness and even death.</p>	
<p>FIRST AID:</p> <p><u>Eye contact:</u> Wash eyes with copious amounts of running water to relieve irritation.</p> <p><u>Skin contact:</u> Remove contaminated clothes. Wash exposed skin with soap and water.</p> <p><u>Inhalation:</u> Remove patient to fresh air; restore breathing if necessary. Promptly contact physician. Advise doctor <u>not</u> to administer adrenalin.</p> <p><u>Ingestion:</u> If taken internally, induce vomiting. Contact physician promptly; Advise doctor <u>not</u> to administer adrenalin.</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Supply maximum ventilation. Confine spill to small area; do not allow run off into sewer. Those involved in clean-up need protection from liquid contact and vapor inhalation. Pick up spill on absorbent solid.</p>	
<p>DISPOSAL: Place in covered container for disposal. Chlorinated solvents in large amount should be burned in an approved incinerator with appropriate fume scrubbing. Also, consult licensed waste disposal company in your locality and consider recovery of perchloroethylene solvent by distillation. Scrap solvent and distillation residues must be handled as toxic waste. Follow Federal, State and local regulations for waste disposal.</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Airborne levels should be kept below TLV levels by use of general ventilation and local exhaust ventilation. Provide floor level ventilation to remove these vapors.</p> <p>For emergency and non-routine exposure above the TLV approved full facepiece respirators should be used - cartridge and canister types up to 500 ppm, and air-supplied or self-contained types above 500 ppm.</p> <p>Neoprene, Viton, PVA or PVC coated gloves should be used to prevent skin exposure. Where splashing is possible, aprons and protective clothing may be indicated. Appropriate eye and face protection should be used. Where eye contamination is possible, an eye wash fountain should be readily available.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Store in a cool, dry, well-ventilated place in closed containers away from fire hazards. High temperature (700°C) or intense UV light can decompose perchloroethylene to toxic and corrosive materials. Smoking, open flame, welding, etc. should not be permitted in area of use or storage.</p> <p>It is recommended that workers with blood pressure, heart, liver, kidney or pulmonary problems, with nervous system disorders, with excessive obesity, or with alcohol consumption problems should not work in proximity to this or other chlorinated solvents. One study has indicated possible teratogenic effects. NIOSH has recommended that this material be handled as if it were a human carcinogen. (Current Intelligence Bulletin No. 20, 1978)</p> <p>DATA SOURCE(S) CODE: 1-9, 12, 21</p>	
<p>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</p>	<p>APPROVALS: MIS, J. M. Nelson CRD Industrial Hygiene and Safety Corporate Medical Staff D. G. Martell M.D.</p>

COMPOUND NO. 21

PHENOL

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION

1145 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854



MSDS # 355

PHENOL (Revision B)

Issued: September, 1980

Revised: September, 1985

From Genium's MSDS Collection, to be used as a reference.

SECTION 1. MATERIAL IDENTIFICATION

17

MATERIAL NAME: PHENOL

OTHER DESIGNATIONS: Carboic Acid, Hydrobenzene, Oxybenzene, Phenic acid, Phenyl Hydrate, Phenyl hydroxide, Phenylic acid, Phenyl alcohol, CAS #000 108 952, C_6H_5OH

MANUFACTURER/SUPPLIER: Available from many suppliers, including;

Dow Chemical USA

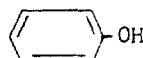
2020 Dow Center

Midland MI 48640 (517) 636-1000



SECTION 2. INGREDIENTS AND HAZARDS

PHENOL



* Current OSHA PEL and ACGIH TLV/STEL (1984-85) (Skin) notation indicates a potential contribution to overall exposure via absorption through the skin.

NIOSH recommends a 10 hr. TWA of 20 mg/m^3 with a ceiling of 60 mg/m^3 for any 15 minute period.

%

HAZARD DATA

ca 100

8 hr TWA: 5 ppm,
19 mg/m^3 (Skin)
STEL: 10 ppm, 38 mg/m^3 *
Human, Oral LDLo:
140 mg/kg
Rat, oral LDLo:
414 mg/kg
Rat, skin LD50:
669 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point @ 1 atm 359.4°F (181.9°C)

Vapor pressure @ 25°C 0.35

Vapor density (Air=1) 3.24

Solubility in water (% by wt.) ... 8.4 @ 20°C
(Sol. in all proportion @ temp. $>66^\circ\text{C}$)

APPEARANCE & ODOR: White crystalline solid with a characteristic sharp medicinal sweet, tangy odor which is detectable above 0.05 ppm. Phenol turns pink or red if it contains impurities or if it is exposed to heat or light.

Specific Gravity ($H_2O=1$):

Solid: 1.017 @ $25/4^\circ\text{C}$

Liquid: 1.0576 @ $41/4^\circ\text{C}$

Melting point 109.4°F (43°C)

Volatiles, % by vol @ 20°C .. ca 100

Evaporation rate (BuAc=1) ... <0.03

Viscosity, CPS, @ 80°C 1.51

Molecular weight 94.12

SECTION 4. FIRE AND EXPLOSION DATA

Lower

Upper

Flash Point and Method

Autoignition Temp.

Flammability Limits in Air

175°F (79°C) C.C.

1319°F (715°C)

% by volume

1.5

8.6

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, or alcohol type foam. Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool fire-exposed tanks/containers. Phenol presents a moderate fire hazard when exposed to heat, flame, or oxidizers. When heated, it emits toxic fumes and vapors which will form explosive mixtures with air. Solid phenol burns with difficulty, giving off a heavy smoke.

Firefighters should wear self-contained breathing apparatus and full protective clothing when fighting fires involving phenol. NOTE: Water containing phenol can cause severe chemical burns.

SECTION 5. REACTIVITY DATA

This material is stable at room temperature under normal handling and storage conditions. It does not undergo hazardous polymerization. Phenol is incompatible with strong oxidizing agents and halogens. Reaction with calcium hypochlorite is exothermic and produces toxic fumes which may ignite. Hot phenol is corrosive to many metals, including aluminum, lead, magnesium, and zinc. Reaction with these materials causes phenol to become discolored. Do not heat phenol above 122°F (90°C).

Thermal decomposition or burning produces oxides of carbon and water.

SECTION 6. HEALTH HAZARD INFORMATION

TLV 5 ppm or 19 mg/m³ (Skin)

Phenol is a general protoplasmic poison which is corrosive to body tissue. Poisoning can occur via skin absorption, vapor inhalation, or ingestion. Vapors of phenol are irritating to the eyes, nose, and throat. The liquid is rapidly absorbed through the skin. Contact with the skin causes a white wrinkled discoloration followed by a severe burn or systemic poisoning if not properly removed. Intense burning and pain from skin contact may be delayed. Absorption of phenol through skin may cause sudden collapse, or death. Symptoms develop rapidly. When ingested, phenol causes burning of the gastrointestinal tract, and blotches on the lips and in the mouth. Headache, nausea, dizziness, dyspnea, shock, convulsions, and death may follow exposures by any route. Chronic exposure to low concentrations of phenol may cause digestive disturbances, nervous disorders, skin eruptions, and death due to liver and kidney damage. The TLV is set to prevent systemic poisoning.

FIRST AID: EYE CONTACT: Immediately flush eyes, including under eyelids, with copious amounts of running water for at least 30 minutes. Get medical attention! (Inplant, community, paramedic). SKIN CONTACT: Immediately flush skin for at least 30 minutes while removing contaminated clothing and shoes. Get medical attention! INHALATION: Remove victim to fresh air. Restore and/or support breathing as necessary. Keep person warm and quiet. Transport to a medical facility. INGESTION: Give victim large quantities of milk or water as quickly as possible. Induce vomiting by touching back of throat with finger. Do not give fluids or induce vomiting if victim is unconscious or is having convulsions. Contact a physician or Poison Control Center and transport to a medical facility.

SECTION 7. SPILL, LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Evacuate all personnel from area, except for those involved in clean-up. Close the leak immediately, if possible. Absorb small spills on paper, vermiculite or other absorbent and place in a closed metal container for disposal. Dike large spills and allow material to cool and solidify. Shovel solid into steel containers for disposal. Flush spill area thoroughly with water and collect flushings and wash water for disposal. Do not allow phenol to enter sewer, watersheds, or waterways! Notify proper authorities including the National Response Center (800-424-8802). Clean-up personnel must wear a self-contained breathing apparatus and full personal protective clothing and equipment. DISPOSAL: Burn contaminated waste in an approved incinerator. Phenol may be recovered by charcoal absorption, solvent extraction or steam stripping. A concentration of 1% by weight is required for economical recovery. Phenol is water soluble and is amenable to biological or chemical oxidation. Solutions can be chemically oxidized by chlorine, chlorine dioxide, or other oxidants. Phenol content of water supply not to exceed 0.001 mg/L. (DO NOT flush phenol down drains.) RCRA Hazardous Waste # U188 Reportable Spill Quantity ... 1000 lbs.

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation (explosion-proof) to meet TLV requirements. When phenol is heated, vapor inhalation can be a serious hazard without proper precaution. For emergency or nonroutine exposures where the TLV may be exceeded, use an appropriate NIOSH-approved full face respirator. Fume hoods should maintain a minimum face velocity of 100 fpm. All electrical service in use or storage areas should have an explosion-proof design. **DANGER!** Avoid any contact with this material. Full protective equipment, including splash goggles, faceshield, impervious gloves, apron, boots, impervious shirt and trousers, hard hat with brim, acid suit and respirator should be available and worn as appropriate. Remove contaminated clothing immediately and do not reuse until it has been properly laundered. Eyewash stations and safety showers should be readily available in use and handling areas. Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from heated surfaces, open flame and ignition sources. Outside or detached storage is preferred. Protect containers from physical damage. Phenol is a very dangerous compound. Do not breathe vapor or allow liquid to come in contact with the skin. Wear appropriate protective equipment and remove contaminated clothing immediately. Use extreme caution when transporting phenol to prevent leaks. Vent containers before heating and do not heat above 140°F (60°C). Do not eat or smoke in areas where this material is being used or handled. Do not allow employees who have diseases of the central nervous system, liver, kidney, or lungs to work in area of phenol exposure. Provide preplacement and periodic medical exams to employees working with phenol. Do not allow untrained workers to handle this material (see also ASTM D2286-Sampling and Handling Phenol).

ICC & DOT - Class B Poison.

LABEL: POISON

DATA SOURCE(S) CODE (See Glossary) 2-12, 15, 19, 23-24, 31, 34, 37, 38, 59, 79, R.

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APPROVALS

INDUST. HYGIENE/SAFETY

MEDICAL REVIEW:

COMPOUND NO. 22

SELENIUM

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION

1145 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854



MSDS # 136

SELENIUM
Metal Powder

Issued: June, 1985

Revised:

From Genium's MSDS Collection, to be used as a reference

SECTION 1. MATERIAL IDENTIFICATION

MATERIAL NAME: SELENIUM

Other Designations: Elemental Selenium, Selenium Metal Powder (DOT): Se; CAS # 007 782 492

MANUFACTURER: Available from several suppliers including:

ASARCO

180 Maiden Lane

New York, NY 10038

(212) 510-2000

Phelps Dodge Refining Corp.

300 Park Avenue

New York, NY 10022

(212) 940-6551

Alloychem, Inc.

641 Lexington Avenue

New York, NY 10022

(212) 644-1510

SECTION 2. INGREDIENTS AND HAZARDS

SELENIUM, Se

%

HAZARD DATA

>99

8 hr TWA: 0.2 mg/m³
(as Se)

Rat, oral:

LD50: 6700 mg/kg

Rat, inhalation:

LDLo: 33 mg/kg/8hr.

* Current (1984-85) ACGIH TLV and OSHA PEL.

SECTION 3. PHYSICAL DATA

Melting point, deg C ... 217 (Crystalline)

40-50 (Amorphous)

Vapor pressure @ 356C, mmHg ... 1

Solubility in water ... insoluble

Boiling point, deg C ... 685

Molecular weight ... 78.96

Specific gravity ... 4.4 to 4.8

Appearance & Odor: The color of Selenium varies depending on its crystalline form. It exists as a gray or red amorphous or crystalline powder. It is odorless. Purified pellets are "BB" size with gray color.

SECTION 4. FIRE AND EXPLOSION DATA

Lower

Upper

Flash Point and Method

Autoignition Temp

Flammability Limits in Air

N/A

N/A

N/A

Extinguishing Media: Use dry powder extinguishing agents.

Fine dust of Selenium may burn if ignited. The burning of Selenium is accompanied by the evolution of Selenium dioxide fume.

Firefighters should wear self-contained breathing apparatus and full protective clothing for protection against dust and corrosive SeO₂ fume.

SECTION 5. REACTIVITY DATA

This material is stable at room temperature under normal storage conditions. It burns in air with a blue flame, forming Selenium dioxide and giving off a characteristic offensive odor. Selenium is insoluble in water, but does dissolve in sulfuric acid, nitric acid, aqua regia and alkaline solutions. Under reducing conditions toxic hydrogen selenide gas can be evolved when Selenium comes in contact with mineral acids and strong bases. H₂Se is also formed when Se reacts with nascent hydrogen. Selenium reacts vigorously with fluorine, chlorine, bromine, and can react violently with chromium trioxide, metal chlorates and potassium and silver bromate and other strong oxidizing agents.

SECTION 6. HEALTH HAZARD INFORMATION

TLV

0.2 mg/m³

Excessive exposure to Selenium salts may cause irritation of the eyes, skin and mucous membranes of the respiratory tract with cough, difficult breathing, dyspnea and headache. Signs of chronic toxicity may include respiratory tract irritation, gastrointestinal distress, metallic taste, pallor, irritability and fatigue. Garlic odor of the breath is characteristic of Se absorption. These effects may be more severe upon inhalation of Selenium dioxide fume formed when elemental Selenium is heated. Selenium fume (SeO₂) is severely irritating to the eyes, skin and respiratory tract due to the formation of corrosive selenious acid when SeO₂ comes in contact with moisture. Toxic effects produced in experimental animals exposed to Selenium include kidney and liver damage and teratogenic effects. Trace amounts of Selenium in food may result in increased dental decay. Recommended exposure limit for Selenium is set to prevent systemic toxicity and minimize eye and respiratory irritation.

FIRST AID: EYE CONTACT: Flush eyes, including the area beneath the lids, with large amounts of running water. Obtain medical attention. SKIN CONTACT: Wash contaminated skin with soap and water. If irritation develops, avoid further contact and seek medical attention. INHALATION: Remove person to fresh air. Restore/support breathing as necessary. Obtain medical assistance. INGESTION: If person is conscious, give them a large quantity (2-3 glasses) of water to drink, then induce vomiting. Seek medical attention (Inplant, Paramedic, or community).

SECTION 7. SPILL, LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of large spills. Ventilate spill area. Clean-up personnel should wear personal protective equipment to prevent dust inhalation and eye/skin contact. Carefully pick-up spilled material using procedures that minimize dust generation, such as vacuuming or wet sweeping. Place material in a suitable container for reclamation or disposal.

DISPOSAL: Reclaim material whenever possible. Unsalvageable waste may be disposed of in sealed containers in an approved secured landfill. Follow federal, state and local regulation.

EPA HAZARDOUS WASTE NUMBER D010 (EP toxicity, 40CFR261.24).

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide local exhaust ventilation to meet TLV requirements. Use a NIOSH approved particulate respirator where airborne concentrations are in excess of the TLV, and during non-routine and emergency operations. Use respirators with protection factors suitable for the suspected airborne concentration.

Dust proof safety goggles should be worn where dusty conditions exist. Use protective clothing such as apron and gloves, if prolonged or repeated contact is likely.

Eye wash stations and washing facilities should be readily available in work areas where the material is handled.

Contact lenses pose a special hazard; soft lenses absorb and all lenses concentrate irritants.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from strong acids, bases, and oxidizers. Protect containers from physical damage.

Maintain good housekeeping practices to prevent accumulation of dust. Use procedures that minimize dust generation. Avoid inhalation of dust and fumes. Use only with adequate ventilation. Wash hands and face before eating, drinking and smoking after handling this material. Do not eat or smoke in work areas where Selenium is handled.

DOT ID # UN2658 (Selenium metal powder, non-pyrophoric).

IMO Class 6.1 (Poison B)

LABEL: St. Andrews Cross (49CFR172.102).

DATA SOURCE(S) CODE (See Glossary) 1, 2, 4-6, 9, 12, 14, 25, 27, 43, 55-59.

Indemnity as to the accuracy of information herein for purchaser's purposes are exclusively purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, GENIUM PUBLISHING CORPORATION extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.

APPROVALS

D.C. RICHARDS, 6/85

INDUST. HYGIENE/SAFETY

D.R. 8/85

MEDICAL REVIEW:

J. S. 8/85

COMPOUND NO. 23

TOLUENE

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



NO. 317

TOLUENE

Revision C

Date August 1979

SECTION I. MATERIAL IDENTIFICATION			
<p>MATERIAL NAME: TOLUENE OTHER DESIGNATIONS: Toluol, Methylbenzene, Phenylmethane, CH₃C₆H₅, GE Material D5B11, ASTM D362 and D841, CAS# 000 108 883 MANUFACTURER: Available from many suppliers, including Shell Chemical Co. and Sun Oil Co.</p>			
SECTION II. INGREDIENTS AND HAZARDS		%	HAZARD DATA
Toluene		ca 100	8-hr TWA 100 ppm (skin)* or 375 mg/m ³ Human, inhalation TCLo 200 ppm (central nervous syst.) Rat, inhalation LCLo 4000 ppm/4 hr Rat, oral LD ₅₀ 5000 mg/kg
<p>*ACGIH (1978); (skin) notation indicates a potential contribution to overall exposure via skin absorption. OSHA/NIOSH (1976) proposed an 8-hr TWA of 100 ppm, with a 15 minute ceiling of 200 ppm, and an action level of 50 ppm. Current OSHA TLV is 200 ppm.</p>			
SECTION III. PHYSICAL DATA			
Boiling point, 1 atm, deg F (C) --- 231 (110.6) Specific gravity (Water=1) -- 0.866 Vapor pressure @ 25 C, mm Hg ----- 28 Volatiles, % ----- 100 Vapor density (Air=1) ----- 3.2 Evaporation rate (BuAc=1) -- 1.9 Solubility in water, % ----- 0.05 Molecular weight ----- 92.15 Appearance & Odor: Water white liquid with a characteristic aromatic odor, whose recognition threshold (unfatigued) is 2-5 ppm (100% of test panel). Odor detection is unsatisfactory for safety because of fatigue.			
SECTION IV. FIRE AND EXPLOSION DATA			LOWER UPPER
Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	
40 F (4.4 C) Closed cup	(536 C) 997 F	% by volume	1.2 7
Extinguishing Media: Carbon dioxide, dry chemical, foam, and water fog. Water may be ineffective for putting out fire, but use spray to cool fire-exposed containers. At room temperature, toluene emits vapors that can form flammable mixtures with air. It is a dangerous fire hazard and a moderate explosion hazard when exposed to heat and flame. Vapors can flow along surfaces to distant ignition sources, then flash back. Firefighters should wear self-contained breathing apparatus and eye protection when fighting toluene fires.			
SECTION V. REACTIVITY DATA			
Toluene is a stable material under normal storage and handling. It does not undergo hazardous polymerization. Since toluene is a flammable liquid, avoid contact with heat, sparks or open flames. Avoid contact with strong oxidizing agents. Nitric acid and toluene, especially in combination with sulfuric acid, will produce nitrated compounds which are dangerously explosive. Oxidation in air can form oxides of carbon and nitrogen.			

SECTION VI. HEALTH HAZARD INFORMATION

TLV 100 ppm (skin) (See Sect. II)

Vapor inhalation can produce headache and slight drowsiness at 100 ppm, fatigue, nausea and itching skin at 100-200 ppm, anesthetic effects and respiratory tract and eye irritation above 200 ppm. Absorption can occur through the skin, and liquid contact will cause defatting of the skin, with possible dermatitis from repeated or prolonged contact. Eye contact is irritating and can be damaging (corneal burns). Ingestion irritates the digestive tract and results in systemic effects from absorption.

FIRST AID:

Eye Contact: Immediately irrigate with water for 15 minutes. Get medical help.

Skin Contact: Wash area with soap & water; remove contaminated clothing promptly.

Get medical help if irritation persists or if large areas of skin were exposed.

Inhalation: Remove to fresh air; restore breathing and give oxygen if needed. Get medical help!

Ingestion: Get medical help as soon as possible! When victim is conscious, give USP mineral oil to drink. (Aspiration is a potential hazard if vomiting occurs!)

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Report large spills to safety personnel. Remove ignition sources; provide explosion-proof ventilation. Those involved in clean-up must use protection against liquid contact and vapor inhalation. Pick up liquid when feasible, or absorb on vermiculite or sand and scoop up with nonsparking tools into a metal container with cover. Liquid can be flushed with a water spray to an open holding area for handling. Do not flush to sewer, to a confined space, or to a watercourse!

DISPOSAL: Consider reclaiming by distillation or disposal via a licensed waste disposal company. Scrap may be incinerated under properly controlled conditions. Follow Federal, State and local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and exhaust ventilation to meet TLV requirements. Ventilation fans & other electrical service must be nonsparking and explosion proof. Exhaust hoods should have >100 fpm face velocity and be designed to capture heavy vapors. Exposure above the TLV for nonroutine and emergency situations requires use of an organic chemical cartridge respirator up to 200 ppm; above 200 ppm a full face piece is required with an approved canister-type gas mask or self-contained breathing equipment. Safety goggles or glasses should be worn in areas of use. Impermeable (neoprene has been recommended) gloves and apron, face shield, and other protective clothing may be needed to prevent skin contact during use, especially where splashing may occur. An eyewash station should be available if splashing is possible. A safety shower and washing facilities should be available.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in cool, clean, well-ventilated area away from sources of heat and ignition and away from oxidizing agents. Area must meet requirements of OSHA Class IB liquid. No smoking in areas of storage or use. Nonsparking tools should be used near toluene. Use safety cans for handling small amounts. Ground and bond metal containers for liquid transfers to prevent static sparks. Protect containers from physical damage. Preplacement and periodic medical exams emphasizing the liver, kidneys, nervous system, lungs, heart and blood should be provided. At least an annual exam is recommended for workers exposed above the action level (50 ppm). Use of alcohol can aggravate the narcotic effect and blood effects of toluene.

DATA SOURCE(S) CODE: 1-9,12,20,21,24,26

APPROVALS: MIS, CRD

Industrial Hygiene
and Safety

MEDICAL REVIEW: 12/79

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COMPOUND NO. 24

1,1,1-TRICHLOROETHANE

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



NO 311
INHIBITED
1,1,1-TRICHLOROETHANE
REVISION D
DATE August 1983

SECTION I. MATERIAL IDENTIFICATION			
<p>MATERIAL NAME: INHIBITED 1,1,1-TRICHLOROETHANE OTHER DESIGNATIONS: Methyl Chloroform, MC, CCl_3CH_3, GE Material D5B79, CAS# 000 071 556, α-Trichloroethane TRADE NAMES & MANUFACTURER: BLACO-THANE (Baron-Blakeslee), CHLOROTHENE NU & VG (Dow), INHIBISOL (Penetone Corp.), TRI-ETHANE (PPG Ind. Inc.), TRITHENE (SRS, Inc.)</p>			
SECTION II. INGREDIENTS AND HAZARDS		%	HAZARD DATA
<p>1,1,1-Trichloroethane Inhibitor, typical*</p> <p>*Inhibitors used are proprietary. Commercial materials contain up to about 5% inhibitor and are designed for cold cleaning or vapor degreasing use or both.</p> <p>**Current OSHA PEL and ACGIH (1983) TLV. ACGIH STEL 450 ppm.</p> <p>NIOSH (1976) proposed a 10-hr TWA of 200 ppm with a 350 ppm ceiling (15 minute sample) and has recommended caution in use</p>		<p>>95 < 5</p>	<p>8-hr TWA 350 ppm** Unknown <u>Human, Inhalation</u> LCLo 27 gm/m³ 10 min <u>TCLo 920 ppm/70 min</u> (CNS effects) <u>Human, Oral</u> TDLo 670 mg/kg (CI effects)</p>
SECTION III. PHYSICAL DATA			
<p>Boiling point, 1 atm, deg F ----- ca 165* Specific gravity, 25/25C --- 1.3-1.336* Vapor pressure, 20 C, mm Hg ----- 100 Volatiles, % ----- ca 100 Vapor density (Air=1) ----- 4.55 Melting point, deg C ----- -32 Water solubility, g/100ml H₂O @20C - 0.09 Evaporation rate (CCl₄=1) -- 1 Molecular weight ----- 133.41</p> <p>Appearance & Odor: Colorless liquid with a mild, sweetish, pleasant, ether-like odor which may be just perceptible (unfatigued) at about 100 ppm in air. *Properties depend on the inhibitor and inhibitor level.</p>			
SECTION IV. FIRE AND EXPLOSION DATA			
Flash Point and Method	Autoignition Temp	Flammability Limits in Air	Lower Upper
None	537 C (998 F)	(High energy ignition source at 25C), Vol. %	8.0% 10.5%
<p>This material is nearly nonflammable. High energy, such as electric arc, is needed for ignition, and the flame tends to go out when the ignition source is removed. Material involved in a fire can emit toxic and irritating fumes. Water fog, carbon dioxide, dry chemical, or foam may be used to fight fires.</p> <p>Use self-contained or air-supplied breathing apparatus for protection against suffocating vapors and toxic and corrosive decomposition products.</p>			
SECTION V. REACTIVITY DATA			
<p>This material can be hydrolyzed by water to form hydrochloric acid and acetic acid. It will react with strong caustic, such as caustic soda or caustic potash to form flammable or explosive material. Attacks natural rubber.</p> <p>It requires inhibitor content to prevent corrosion of metals; and when inhibitor is depleted, it can decompose rapidly by reaction with finely divided white metals, such as aluminum, magnesium, zinc, etc. Do not use these metals for storage containers or in pressurized spraying equipment where MC is involved.</p> <p>It will decompose at high temperature upon contact with hot metal, or under ultra-violet radiation to produce toxic and corrosive gases (hydrogen chloride, dichloroacetylene, chlorine and some phosgene).</p>			

SECTION VI. HEALTH HAZARD INFORMATION		TLV 350 ppm or 1900 mg/m ³
<p>Brief exposure at 900-1000 ppm causes mild eye irritation and loss of coordination due to the early effects of MC on the CNS. Excessive exposure gives headache, drowsiness, impaired judgement, unconsciousness. Defats skin on contact, can produce irritation and dermatitis; can be absorbed through the skin. Eye contact gives pain and irritation. Considered low in toxicity among the chlorinated hydrocarbons.</p> <p>FIRST AID:</p> <p><u>Eye contact:</u> Flush eyes well with plenty of running water for 15 min, including under eyelids.</p> <p><u>Skin contact:</u> Remove solvent-wet clothing promptly. Wash contact area with warm water and soap. Get medical attention for irritation.</p> <p><u>Inhalation:</u> Remove to fresh air. Restore and/or support breathing as needed. Get medical assistance. (Note: Advise physician not to use adrenalin.)</p> <p><u>Ingestion:</u> Contact physician. Aspiration a hazard! Possible spontaneous vomiting. (If medical help not readily available and amount swallowed was appreciable, give milk or water to drink and induce vomiting. Repeat. Estimated lethal dose for 150 lb man is 0.5 to 1 pint.)</p> <p><u>PHYSICIAN:</u> Avoid using sympathomimetic amines in treatment.</p>		
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES		
<p>For <u>small</u> spills in ventilated area, mop, wipe or soak up with absorbent material avoiding inhalation and contact. Evaporate outdoors or in an exhaust hood.</p> <p>For large spills, inform safety personnel and evacuate area. Use protective equipment during clean-up (see Sect. VIII). Ventilate area. Contain liquid, pick up and place in closed metal containers. Do not allow to enter drains and water ways.</p> <p><u>DISPOSAL:</u> Dispose of via a licensed waste solvent disposal company, or reclaim by filtration and distillation procedures. Follow Federal, State and Local regulations.</p> <p>Aquatic toxicity TLM 96: 100-10 ppm.</p> <p>EPA hazardous waste number under RCRA is U226 (40CFR261).</p>		
SECTION VIII. SPECIAL PROTECTION INFORMATION		
<p>Provide general and local exhaust ventilation to meet TLV requirements. Air-supplied or self-contained respirator should be available for non-routine or emergency use. A chemical cartridge-type respirator can be used for a limited time below 1000 ppm. A full facepiece is needed above 500 ppm.</p> <p>Chemical goggles or a face shield should be worn if splashing is possible. Gloves and apron (of neoprene, polyethylene or polyvinyl alcohol) should be worn when needed to avoid skin contact. Remove solvent-wet clothing promptly. A safety shower and eyewash station should be available to use area if splashing is probable.</p> <p>Preplacement and periodic medical examinations should consider cardiovascular, liver, CNS functions, and skin.</p>		
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS		
<p>Store in closed containers in a cool, well-ventilated area. Keep water-free. Monitor inhibitor level for vapor degreasing use. Use caution in cleaning operations involving white metal fines (see Sect. V). Trichloroethylene contamination may cause decomposition when aluminum is degreased.</p> <p>Provide medical monitoring of those regularly exposed to MC in the workplace. Preclude those with CNS, liver, or heart disease from exposure. Personnel using this solvent should avoid drinking alcoholic beverages shortly before, during, or soon after exposure.</p> <p>NIOSH (1976 Crit. Doc.) expressed concern because of possible birth defects from high level pregnant rat exposures. Since 1976, directed studies have been negative. At occupational physicians' seminar on "Reproductive Hazards in the Workplace," Washington, DC (4/25/83), no physician was aware of data to substantiate the NIOSH concern.</p> <p>DOT Classification: ORM-A I.D. No. UN2831</p> <p>DATA SOURCE(S) CODE: 1-12, 14, 20, 23, 25, 26, 30, 31, 34, 37, 38, 45-49, 53</p>		
<p>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</p>		<p>APPROVALS: MIS/CRD <i>J.M. Nelson</i></p> <p>INDUST. HYGIENE/SAFETY <i>JN 7-21-83</i></p> <p>MEDICAL REVIEW: 1 August 1983</p>

COMPOUND NO. 25

TRICHLOROETHYLENE

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 312

TRICHLOROETHYLENE

Revision D

Date July 1979

SECTION I. MATERIAL IDENTIFICATION						
MATERIAL NAME: TRICHLOROETHYLENE OTHER DESIGNATIONS: TCE, Trichloroethylene, Ethylene Trichloride, Ethenyl Trichloride, CHCl=CCl ₂ , GE Material D5B56, CAS# 000 079 016 MANUFACTURER & TRADE NAMES: BLACO-TRI (Baron-Blakeslee); ALK-TRI, HI-TRI and NEU-TRI (Dow); KAYNIDE (Kraft); PERM-A-CLO and TRIAD (Detrex); TRICHLOR (PPG); TRICLENED & MD (Diamond Shamrock)						
SECTION II. INGREDIENTS AND HAZARDS			%		HAZARD DATA	
Trichloroethylene + Stabilizer*			ca 100		TLV 100 ppm with 200 ppm Ceiling level** Human, Oral LDLo 857 mg/kg Human, Inhal. TCLo 160 ppm/83 min (central nervous system)	
*Stabilizers such as amines or epoxy compounds are usually added at low levels to increase resistance to oxidation and to polymerization. Vapor degreasing grades require higher stabilizer levels. **ACGIH (1979 Intended Changes List) proposes an 8-hr TWA of 50 ppm with STEL 150 ppm. NIOSH (1978) reviewed TCE as a suspected carcinogen and suggested a TWA of 25 ppm as readily attainable. <u>Unresolved controversy</u> on TCE carcinogenicity at present.						
SECTION III. PHYSICAL DATA						
Boiling point, 1 atm, deg F (C) ---- 188 (87) Specific gravity 20 C ---- 1.45-1.47* Vapor pressure @ 20°C, mm Hg ----- 58 Volatiles % ----- ca 100 Vapor density (Air = 1) ----- 4.54 Evaporation rate (CCl ₄ =1) - 0.69 Water solubility @ 25°C, % ----- 0.1 Freezing point, deg C ---- -73 to -86* Molecular weight ----- 131.39						
Appearance & Odor: Colorless, mobile liquid with a characteristic, sweet, ether-like odor whose recognition threshold is 21.4 ppm in air (unfatigued, 100% of test panel). *Depends on stabilizer and level used.						
SECTION IV. FIRE AND EXPLOSION DATA					LOWER	UPPER
Flash Point and Method		Autoignition Temp.	Flammability Limits @ 57C	15	40	
None		770 F (410 C)	in air, Vol % @100C	2.5	90%	
Extinguishing Media: Use that which is appropriate for surrounding fire. Trichloroethylene is normally considered noncombustible. However, when 15% vapor in air at 33 C is exposed to intense heat (electric arc) or to ordinary flame at vapor-air temperatures exceeding 50 C, it can be made to burn mildly. Combustibility increases in O ₂ -enriched air. Self-contained breathing apparatus should be used for protection against TCE vapors and their toxic and corrosive decomposition products in a fire situation.						
SECTION V. REACTIVITY DATA						
TCE is considered to be a stable compound under normal conditions of storage and handling. However, when it is heated (as in a vapor degreaser) or exposed to sunlight, it requires stabilization against oxidation, degradation and polymerization. When it is exposed to high temperatures, hydrogen chloride and phosgene (highly toxic) can be produced as decomposition products. It is slowly decomposed by light when moist. TCE can react with NaOH, KOH, or other strong alkali to form explosive mixtures of chloroacetylenes. Soda ash does not react. Polymerization of TCE is catalyzed by aluminum chloride. Magnesium or aluminum powder can react with TCE.						

SECTION VI. HEALTH HAZARD INFORMATION	TLV 100 ppm or 535 mg/m ³ (See Sect II)
<p>Inhalation of TCE above the TLV can irritate nose and throat, with dizziness, drowsiness, headache, nausea, unconsciousness, and even death resulting from excessive exposure. Eye irritation and lacrymation can result from exposure to vapor or liquid. Skin contact causes irritation and, when prolonged or repeated, dermatitis. Ingestion irritates the digestive tract and may cause nausea and rapid drowsiness partial paralysis, unconsciousness and kidney failure can result in severe cases.</p>	
FIRST AID:	
<p><u>Eye contact:</u> Wash immediately with plenty of running water. Continue washing to minimize discomfort. Get prompt medical attention.</p>	
<p><u>Skin contact:</u> Remove contaminated clothing. Wash with soap and warm water.</p>	
<p><u>Inhalation:</u> Remove to fresh air; restore breathing if required. Keep at rest and warm. Immediately contact physician; advise him not to give adrenalin.</p>	
<p><u>Ingestion:</u> Get immediate medical help! Do not induce vomiting unless directed by a physician. (Authorities differ; professional decision required). Physician should be warned <u>not to use</u> adrenalin for treatment.</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Inform safety personnel and evacuate area for large spills. Clean-up personnel should use respiratory and liquid contact protection. Provide ventilation. Confine spill to as small an area as possible. Do not allow run off to the sewer. Pick up spill with vacuum or on an absorbent and store in closed container for disposal.</p>	
<p><u>DISPOSAL:</u> Waste can be processed to recover TCE, or it can be burned in an appropriately equipped, high temperature incinerator (fume scrubbing system required to remove HCl). Disposal through a licensed waste disposal company should also be considered. Scrap solvent and distillation residues must be handled as toxic wastes. Follow Federal, State and local regulations.</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Provide general ventilation and exhaust ventilation to keep workplace vapor levels within TLV requirements</p>	
<p>Approved respiratory equipment should be available for emergency and nonroutine use. Use self-contained breathing equipment above 1000 ppm; use full facepiece cartridge or canister respirators for limited exposures above ceiling limit or TLV. (Cartridge, 1-2 hrs max.)</p>	
<p>Use neoprene gloves, aprons etc. to prevent liquid contact with the skin and splash-proof goggles for eye protection. Gas-tight goggles should be used by maintenance and emergency personnel.</p>	
<p>An eyewash station should be available where splashing is probable.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Avoid breathing vapors. Avoid skin contact. Store in a cool, well-ventilated area and use with adequate ventilation, including floor level ventilation. Avoid contact of vapors with high temperature (toxic and corrosive decomposition products from TCE above 700 C). No smoking in use or storage areas.</p>	
<p>Avoid collecting aluminum fines or chips in vapor degreaser. Regularly monitor TCE stabilizer level. Only trained personnel should operate vapor degreaser.</p>	
<p>TCE has produced liver cancer in test animals. Exercise due caution in use. Evidence of cancer hazard with TCE is greater than with perchloroethylene or 1,1,1-trichloroethane. (OSHA Reporter 1978, 1565). However, observed effects may be due to stabilizers used (not TCE itself).</p>	
DATA SOURCE(S) CODE: 1-9, 12, 14, 21	APPROVALS: MIS, CRD <i>J. M. White</i>
<p>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use</p>	Industrial Hygiene and Safety <i>O. G. White</i>
MEDICAL REVIEW: 12/79	

COMPOUND NO. 26

TRICHLOROFLUOROMETHANE

Material Safety Data Sheet

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855



GENIUM PUBLISHING CORP.

No. 309
FLUOROTRICHLORO-
METHANE
(Revision C)
Issued: August 1974
Revised: February 1986

SECTION 1. MATERIAL IDENTIFICATION

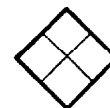
19

MATERIAL NAME: FLUOROTRICHLOROMETHANE

OTHER DESIGNATIONS: Trichlorofluoromethane, Propellant 11, CCl₃F, Monofluorotrichloromethane,
CAS #0075-69-4

TRADE NAMES AND MANUFACTURERS: FREON 11 and FREON MF (Du Pont);
GENETRON 11 (Allied); ISOTRON 11 (Pennwalt); UCON 11 (Union Carbide).

HMIS Not Found
H: 1
F: 0 R 1
R: 0 I 1
PPE: * S 1
* See Sect. 8 K 0



SECTION 2. INGREDIENTS AND HAZARDS

%

HAZARD DATA

FLUOROTRICHLOROMETHANE

ca 100

8-hr TWA: 1000 ppm*
or 5600 mg/m³

Rat, Inhalation, LCLo:
10 pph/20 min.

Human, Inhalation,
TC₅₀: 50,000 ppm/30 min.

* Current OSHA PEL. ACGIH (1985-86) TLV ceiling value.

SECTION 3. PHYSICAL DATA

Boiling Point, 1 atm ... 74.7°F (23.8°C)
Vapor Pressure @ 70°F, mm Hg ... 690
Vapor Density (Air = 1) ... 5.0
Solubility in Water at 25°C, 1 atm, wt. % ... 0.11
Specific Gravity (17/4°C) ... 1.494

Volatiles, % ... 100
Evaporation Rate (CCl₄ = 1) ... 0.1
Freezing Point ... -169°F (-111°C)
Molecular Weight ... 137.37

Appearance and Odor: Colorless, nearly odorless, volatile liquid. At concentrations above 20% in air it has a mild, ethereal odor resembling that of CCl₄, (carbon tetrachloride).

SECTION 4. FIRE AND EXPLOSION DATA

LOWER UPPER

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
Nonflammable	NA	Nonflammable	NA	NA

EXTINGUISHING MEDIA: Use whatever is appropriate for surrounding fire.

Fluorotrichloromethane is a nonflammable material. Vapors are five times heavier than air. High concentrations may tend to accumulate in low-lying areas.

Fire fighters should wear self-contained breathing apparatus and fully protective clothing against suffocating vapors and toxic and corrosive decomposition products.

SECTION 5. REACTIVITY DATA

Fluorotrichloromethane is a very stable material in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.

Prevent exposure to alkali or alkaline earth metals such as sodium, potassium, etc. Magnesium and aluminum may also be reactive, especially in the finely ground or powdered state or at high temperatures.

Thermal-oxidative degradation can produce toxic and corrosive materials such as halogens, carbonyl halides, and phosgene.

SECTION 6. HEALTH HAZARD INFORMATION | TLV

High concentrations of fluorotrichloromethane vapors may cause asphyxiation because of dilution of available oxygen in air below levels necessary to sustain life. Symptoms can include lightheadedness, giddiness, disorientation, shortness of breath, and possible cardiac arrhythmias. Vapors may have little or no effect on the eyes. Prolonged or repeated skin contact with liquid may cause defatting of tissue.

FIRST AID: **EYE CONTACT:** Flush thoroughly with running water for 15 minutes (including under eyelids). **SKIN CONTACT:** Remove contaminated clothing. Flush affected area with water. **INHALATION:** Remove to fresh air. Restore and/or support breathing as needed. **INGESTION:** Seek physician (not expected as a hazard).

Seek prompt medical assistance for further treatment, observation, and support. **DO NOT USE** epinephrine or similar drugs because they can produce cardiac arrhythmias, including ventricular fibrillation.

Fluorotrichloromethane is not listed as a carcinogen by the NTP, IARC, or OSHA.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Remove sources of heat or open flame. Provide adequate ventilation. Cleanup personnel to use self-contained respirator and protective clothing. Stop leakage if possible; remove leaking containers to safe area for discharge and allow to evaporate in an area remote from buildings and people.

DISPOSAL: Material can be reclaimed by distillation. Avoid discharge to environment when possible. Return scrap to supplier, if possible. Follow Federal, state, and local regulations.

EPA Hazardous Waste No.: U121; F001, F002

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide adequate mechanical ventilation to keep vapors below the TLV level. Supply ventilation for sumps and low-lying areas where the dense vapors of this material may collect. Local exhaust should be used where large amounts are released. Use approved self-contained or air-supplied breathing apparatus and lifelines for emergencies. Use chemical safety goggles and/or face shield to prevent liquid contact with eyes where splashing is possible. Wear neoprene or butyl gloves and clothing appropriate for the work situation to minimize skin contact with liquid.

Eyewash stations and safety showers should be readily accessible near areas of use.

Contact lenses may pose a special hazard: soft lenses may absorb and all lenses concentrate irritants.

Vaporization of excessive amounts can displace oxygen necessary for breathing and may cause suffocation when used in confined spaces or areas without ventilation.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store containers in a cool (below 125°F, 51.6°C), dry, well-ventilated area away from open flame and heat sources. Arc-producing equipment or other high-temperature equipment should not be used in a fluorinated hydrocarbon atmosphere. Protect containers from physical damage. High-density vapors may displace air and present an asphyxiation hazard. Concentrations well below the TLV level can damage space heaters when drawn into the combustion chamber. Heater should have independent air supply.

Prevent skin and eye contact with liquid. Avoid inhalation of vapors. Thermal decomposition products can form halogen acids that have very sharp stringent effects and can be detected by odor. Such odor is a hazard warning; when detected, immediately evacuate the area and ventilate.

Data Source(s) Code: 1-8,12,17,26,33,38,47, 82. CK

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Approvals

Indust. Hygiene/Safety

Medical Review

COMPOUND NO. 27

XYLENE

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 1148

DOLPH T-200X

Date August 1978

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: DOLPH T-200X
OTHER DESIGNATIONS: Xylene, CAS# 001 330 207
MANUFACTURER: J. C. Dolph Company
New Road
Monmouth, NJ 08852

Telephone:
(201) 329-2333

SECTION II. INGREDIENTS AND HAZARDS

Xylene

100

HAZARD DATA

8-hr TWA 100 ppm
(skin)*

Inhalation, human
TCLo 200 ppm
(irritation)
Oral, rat LD₅₀
4.3 g/kg

*ACGIH (1977) uses (skin) notation to indicate that absorption of xylene isomers through the skin and can significantly contribute to overall exposure.

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg F -	281	Specific gravity (H ₂ O=1) -	0.869
Vapor pressure, mm Hg -----	10	Volatiles, % -----	ca 100
Vapor density (Air=1) -----	3.66	Evaporation rate (BuAc=1) -	0.75
Water solubility -----	Negligible		

Appearance & Odor: A water-white colored liquid with an aromatic hydrocarbon odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
81 F (TCC)		Volume %	1.0	7.0

Extinguishing media: Carbon dioxide, dry chemical, foam, or water (fog or steam) to exclude air. Use water spray to cool fire-exposed containers.

Firefighters should use self-contained respirators for confined areas.

Dense xylene vapors can flow along surfaces for considerable distances, reach a distant ignition source, and flash back.

SECTION V. REACTIVITY DATA

This material is stable under normal storage and use conditions. Does not polymerize.

This flammable liquid is incompatible with oxygen or strong oxidants. Incomplete combustion may produce carbon monoxide.

It may dissolve or swell plastics and rubber.

SECTION VI. HEALTH HAZARD INFORMATION	TLV 100 ppm (skin)
<p>Excessive inhalation exposure may produce results ranging from irritation, dizziness, and mild depression to convulsions and loss of consciousness, depending on the level and time of exposure. Skin and eye contact can be irritating and damaging. Xylene can be absorbed through intact skin. Ingestion may cause poisoning. Aspiration is a hazard if this material is swallowed. (Aspiration of as little as one ounce could be fatal. Inhalation of high concentrations can cause pulmonary edema.)</p> <p>FIRST AID:</p> <p><u>Eye contact:</u> Flush well with water for 15 minutes. Get medical attention!</p> <p><u>Skin contact:</u> Wash contact area with soap and water. Remove contaminated clothing promptly.</p> <p><u>Inhalation:</u> Remove to fresh air. Restore breathing if necessary. administer oxygen. Call a physician.</p> <p><u>Ingestion:</u> Get medical attention immediately!</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Notify safety personnel and evacuate area if large spill. Remove all ignition sources. Provide maximum explosion-proof ventilation. Recover free liquid. Use absorbent solid (dry sand or vermiculite) to pick up residues with non-sparking tools and place in a covered metal container for disposal. Clean-up personnel must use protective equipment to avoid inhalation of vapors or contact with liquid.</p> <p>DISPOSAL: Scrap material can be incinerated in accordance with Federal State and local regulations. Consider reclamation procedures for large amounts or dispose of through a licensed waste disposal company. <u>Do not</u> flush xylene to sewer or water way! Notify fire and health agencies if this should occur.</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Provide suitable explosion-proof, general and local exhaust ventilation to meet TLV requirements. Use >100 lfm face velocity for exhaust hoods. Provide approved organic canister respirators for short term use up to 1000-2000 ppm and self-contained breathing equipment for higher levels.</p> <p>Use Buna-N rubber gloves and aprons to prevent skin contact, and safety glasses or goggles for eye protection. An eye wash station should be readily accessible to xylene use areas.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Store in closed containers in a clean, cool, well-ventilated area away from oxidizing agents and ignition sources. Electrically bond and ground containers for transfers. No smoking in areas of use or storage.</p> <p>Avoid inhalation of vapors and contact with liquid. Use only with adequate ventilation.</p>	
DATA SOURCE(S) CODE: 1, 2, 4, 6, 12	<p>APPROVALS: MIS, CRD <i>J. M. Wilson</i></p> <p>Industrial Hygiene and Safety <i>D. G. White</i></p> <p>Corporate Medical Staff <i>B. F. Martin M.D.</i></p>
<p><small>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</small></p>	

COMPOUND NO. 28

ZINC



SECTION 1. MATERIAL IDENTIFICATION			19
MATERIAL NAME: ZINC METAL/POWDER		HMIS H: 1 F: 1 R: 1 PPE: * * See Sect. 8	
OTHER DESIGNATIONS: Spelter; CAS #7440-66-6; ASTM B-69; Zn			
DESCRIPTION: Shining white, malleable, blue-gray metal; bars, sheets, wire, foil, flake, and powder.		R 0 I 2 S 1 K -	
MANUFACTURERS: Available from several suppliers, including: Meadowbrook Corp., 30 Rockefeller Plaza, New York City, NY 10112; Telephone: (212) 582-0420			
COMMENTS: Commonly used for galvanizing iron and other metals, electroplating, battery cells, and as an alloying component of brass or bronze. Zinc oxide is used as a pigment in cosmetics and ointments.			
SECTION 2. INGREDIENTS AND HAZARDS		HAZARD DATA	
ZINC; CAS #7440-66-6 * Current ACGIH (1985-86) TWA is 5 mg/m ³ as ZnO fume, while STEL for ZnO is 10 mg/m ³ . Metallic zinc particulates can be considered a nuisance dust.	% >98	OSHA PEL* as Zinc Oxide: 5 mg/m ³ ----- Human, Inhalation TCLO: 1 hr.	
SECTION 3. PHYSICAL DATA			
Boiling Point ... 1664.6°F (907°C) Melting Point ... 788°F (420°C) Vapor Pressure ... 736°C mm Hg 100 Percent Volatile by Volume ... Not Found Water Solubility ... Insoluble		Molecular Weight ... 65.38 Vapor Density (Air = 1) ... Not Found Evaporation Rate ... Not Found Specific Gravity (H ₂ O = 1) ... 7.14	
Appearance and odor: Bright gray-white metallic solid, foil or particulate. No odor.			
SECTION 4. FIRE AND EXPLOSION DATA			LOWER
Flash Point and Method Not Found	Autoignition Temp. Powder/650 millijoules	Flammability Limits In Air Dust Cloud Exp. Level	UPPER
NEPA CLASSIFICATION: 1. EXTINGUISHING MEDIA: Special mixtures of dry chemical or clean, dry sand. Dust will form explosive mixtures with air. Bulk dust in a damp state may generate heat through chemical reaction and hydrogen gas. UNUSUAL FIRE/EXPLOSION HAZARDS: Zn may generate toxic fumes when heated, causing metal fume fever (see sect. 6). Fire fighters should use self-contained breathing apparatus when fighting fires involving zinc or zinc powder. SPECIAL FIRE-FIGHTING PROCEDURES: Zinc and zinc powder will burn in chlorine gas. Care should be taken to ensure that fires involving bulk quantities of zinc powder that are extinguished with water do not generate heat or possible hydrogen gas with subsequent reignition through the reaction of zinc powder and water. Concentrations of zinc oxide powder should remain open and not be sealed to allow safe drying.			
SECTION 5. REACTIVITY DATA			
Zinc metal/powder is stable. Hazardous polymerization cannot occur.			
CHEMICAL INCOMPATIBILITIES: Contact with acids or alkaline hydroxides will yield hydrogen gas. Zinc may react with halogenated hydrocarbon solvents to form salts and hydrogen gas. The combination of zinc and carbon disulfide will result in an incandescent reaction.			
CONDITIONS TO AVOID: Bulk zinc dust should be kept in dry, well-ventilated storage to prevent reaction with water and generation of hydrogen gas. Zn powder reacts explosively with manganese chloride. Zn is resistant to fluorine, chlorine, and bromine, but it reacts strongly with these halogens in the presence of water vapor.			
HAZARDOUS DECOMPOSITION PRODUCTS: Zinc and zinc powder will react with water to generate hydrogen gas.			
COMMENTS: When combined with oxygen, zinc or zinc powder will generate a fume that can result in metal fume fever (see sect. 6).			

SECTION 6. HEALTH HAZARD INFORMATION | TLV

This product is not considered a carcinogen by the NTP, OSHA, or IARC.

SUMMARY OF RISKS: Zinc metal in most forms is not toxic and is not readily absorbed through the skin, GI tract, or lungs. Zn is considered essential to life. Although most inorganic Zn compounds are potential causes of gastroenteric irritation, a high-level dose is relatively nontoxic when ingested. Inhalation of zinc fumes normally generated by zinc and extreme heat may cause metal fume fever, which is accompanied by dryness and irritation of the throat, coughing and dyspnea, a feeling of weakness, muscle pain, and general malaise. Removal from exposure will normally alleviate symptoms, with no residual or chronic effects.

TARGET ORGANS: Lungs, skin.

PRIMARY ENTRY: inhalation, dermal contact.

ACUTE EFFECTS: Inhalation of high levels of zinc fumes may cause metal fume fever.

CHRONIC EFFECTS: Prolonged skin contact may cause a drying dermatitis. Zinc and zinc powder have little history of causing chronic effects.

FIRST AID: **EYE CONTACT:** Flush well with running water to remove particulates; get medical attention if irritation persists.* **SKIN CONTACT:** For cuts, dermal abrasion, irritation, or thermal burns, get medical attention.*

INHALATION: Remove person to fresh air; get medical attention if symptoms persist.* **INGESTION:** Get medical help if large amount is ingested.

* GET MEDICAL ASSISTANCE = In plant, paramedic, community.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Notify safety personnel of large powder spills. Clean up, minimizing dust generation, heat, sources of ignition, and moisture. Approved, grounded vacuum cleaners may be used for final cleanup. Place picked-up powder in closed, pressure-vented, dry metal containers.

DISPOSAL: Deposit unsalvageable waste in an approved landfill per Federal, state, and local regulations. Zinc powder should not be shipped if it is wet.

COMMENTS: Consider EPA Code D 001 or D 003 for Zn powder disposal.

SECTION 8. SPECIAL PROTECTION INFORMATION

GOGGLES: Wear safety goggles to prevent eye contact with particulates.

GLOVES: Wear tightly woven, nonstatic-generating, protective clothing. Special protective clothing is needed for work with hot or molten Zn.

RESPIRATOR: Use NIOSH-approved respirator when dust/fume exceeds the TLV.

VENTILATION: Provide local (explosion-proof) exhaust ventilation to meet TLV requirements. An approved dust-collection system is needed to gather airborne particulates.

OTHER: Preplacement and periodic examination of personnel is suggested. Eyewash stations should be accessible outside the use area. Use of contact lenses in areas of Zn particulate generation should be prohibited because they pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Solid zinc metal does not need special storage segregation; however, zinc powder should be stored dry in a storage area free from ignition sources, chlorine, bromine, or fluorine gas and/or acids.

SPECIAL HANDLING/STORAGE: Follow approved cleaning techniques for zinc powder. Good handling is necessary to control powder dispersal and prevent generation of airborne particulates.

ENGINEERING CONTROLS: Facilities for handling large amounts of zinc powder require special design; approved procedures; use of grounded, electrical, nonsparking tools; and emergency planning for fire and spills.

COMMENTS: See NFPA 491M

NOT designated as a hazardous substance by EPA (40 CFR 116)

DOT Classification: Zn Powder - Flammable Solid

UN1436

Data Source(s) Code: 2-12, 14, 26, 31, 37, 41, 59, 61, 62, 82, 84, OW

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Approvals

Indust. Hygiene/Safety

Medical Review

FIGURES

THE FOLLOWING INFORMATION IS REQUESTED TO DETERMINE YOUR
CURRENT MEDICAL STATUS

Date

1. Name (Last, First, Middle Initial)			3. Social Security Number		
2. Employee Address (Number & Street)		City - State		Zip Code	
4. Telephone Number					
5. Sex* <input type="checkbox"/> M <input type="checkbox"/> F	6. Birth Date*	7. Name and Address of Person to Notify in an Emergency			8. Telephone Number
9. Personal Physician		Address		Telephone Number	11. Type of Examination <input type="checkbox"/> Pre-Placement <input type="checkbox"/> Periodic <input type="checkbox"/> Other (Specify)
10. Which Division or Facility			Position		12. I.D. or Clock No.
13. Work Location					
14. Please Check if You Have Been Immunized For:					15. Are You:
<input type="checkbox"/> Tetanus		<input type="checkbox"/> Smallpox		<input type="checkbox"/> Polio	
<input type="checkbox"/> Don't Know		<input type="checkbox"/> Don't Know		<input type="checkbox"/> Others	
				<input type="checkbox"/> Don't Know	
LAST DATE		LAST DATE		LAST DATE	
15. Are You: <input type="checkbox"/> Right Handed <input type="checkbox"/> Left Handed <input type="checkbox"/> Ambidextrous					

16. Family History*				CHECK EACH BOX (If answer is yes, state blood relationship)		
RELATION	AGE	STATE OF HEALTH	IF DEAD, CAUSE AND AGE	YES	NO	RELATION
Father						Cancer
Mother						Diabetes
Spouse						Stomach Trouble
Grandparents						Kidney Trouble
						Heart Trouble
						Tuberculosis
						Mental Disorder
Brothers and Sisters						Convulsions
						Arthritis
						Allergies
						Other
Children						

17. Personal History*

DO YOU HAVE, OR HAVE YOU EVER HAD ANY OF THE FOLLOWING: (Check Each Box)

	YES	NO		YES	NO		YES	NO
Anemia			Female Disorders			Malaria		
Asthma			Foot Trouble			Nervous Breakdown		
Cancer, Cyst, Tumor or Growth			Frequent Indigestion or Heartburn			Nervous Trouble of Any Sort		
Chest Pain or Shortness of Breath			Frequent or Painful Urination			Numbness, Weakness		
Chills, Fever, Night Sweats			Frequent Trouble Sleeping			Palpitation or Pounding Heart		
Chronic Cough or Colds			Gall Bladder Trouble			Prostate Trouble		
Convulsions, Fits, or Falling Sickness			Goiter or Thyroid Problem			Reaction from Medicines		
Coughing Up, Spitting, or Vomiting Blood			Hayfever or Allergies			Recent Gain or Loss of Weight		
Depression or Excessive Worry			Headaches, Frequent or Severe			Rheumatism or Arthritis		
Diabetes, or Sugar in Urine			Heart Trouble			Scarlet Fever or Rheumatic Fever		
Dizziness			Hemorrhoids or Rectal Trouble			Skin Rash or Hives		
Ear, Nose, or Throat Trouble			Hernia or Rupture			Stomach Trouble, Ulcers		
Epilepsy			High Blood Pressure			Swelling of Ankles or Feet		
Eye Trouble			Jaundice or Hepatitis			Swollen or Painful Joints		
Fainting			Kidney Trouble or Blood in Urine			Tuberculosis or Pleurisy		
Fatigue, Chronic or Frequent			Liver Trouble			Varicose Veins		
			"Locked" Knee or "Trick Joint"			Veneral Disease		
			Loss of Appetite, Chronic			Other		

FIGURE 1. MEDICAL DATA SHEET (1 of 2)

18. Injuries: Please Check Any Injuries You Have Had

☐ Fractures/Broken Bones
☐ Severe Burns
☐ Other Injury

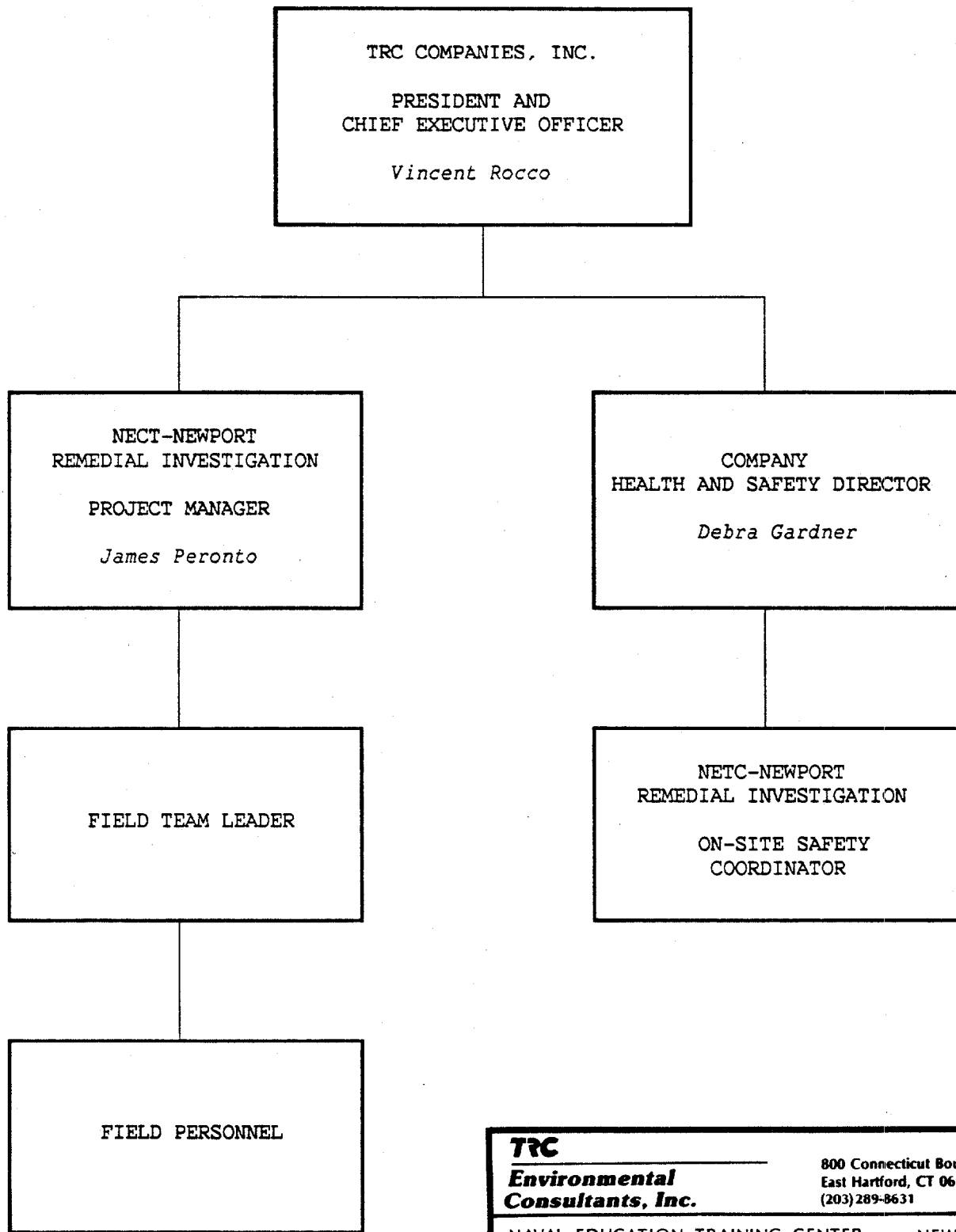
☐ Severe Cuts
☐ Dislocations
☐ None

☐ Loss of Consciousness
☐ Low Back Pain

☐ Back Injury
☐ Loss of Arm, Leg,
 Finger, Toe

19. Check Yes or No. If Yes, Give Details in Blank Area

	YES	NO
a. Any Time Loss From Work Past Two Years Due to Illness.		
b. Any Brace or Support Worn		
c. Discharged or Disqualified From Armed Services for Any Reason.		
d. Military Service - Dates and Locations.		
e. Applied for, or Received Workmen's Compensation.		
f. Been Exposed to Work With Dusts, Radiation, Excessive Noise, Chemicals.		
g. Have You Been Unable to Hold a Job Because of:		
1. Sensitivity to Chemicals, Dust, Sunlight, etc.		
2. Inability to Perform Certain Motions.		
3. Inability to Assume Certain Positions.		
4. Other Medical Reasons.		
h. Been a Patient in a Hospital or Sanitarium.		
i. Had Surgery Recommended or Performed Date and Type.		
j. Are You Taking Medicines Now.		
k. Have You Been Turned Down on a Physical Examination or Been Informed of Any Abnormal Findings From a Physical Examination.		
l. Do You Smoke - If Yes, Quantity Per Day.		
m. Do You Use Alcoholic Beverages - If Yes, Quantity Per Day.		
n. Have You Lived or Travelled Outside the Continental U.S.A.		
o. Allergies.		



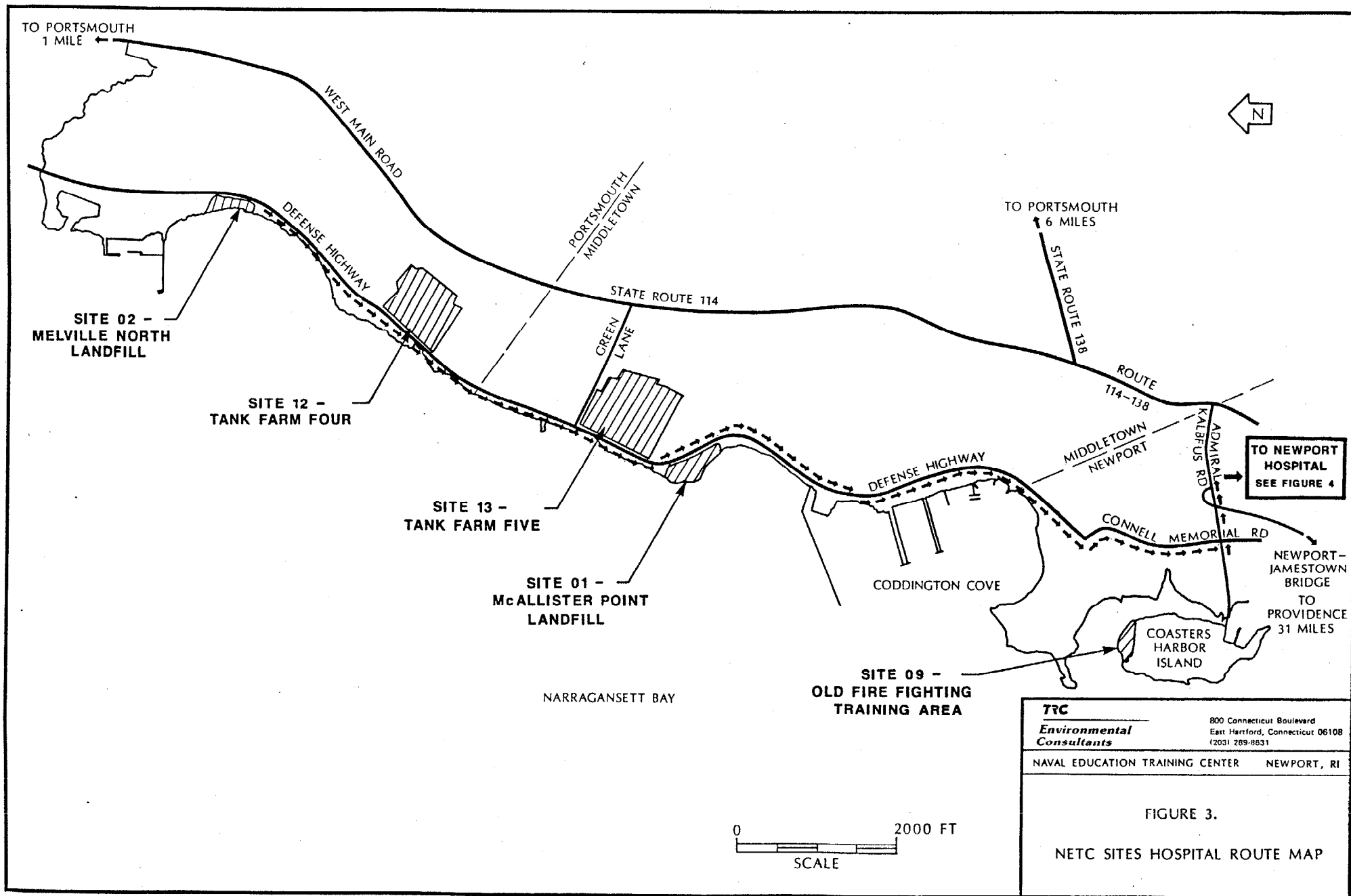
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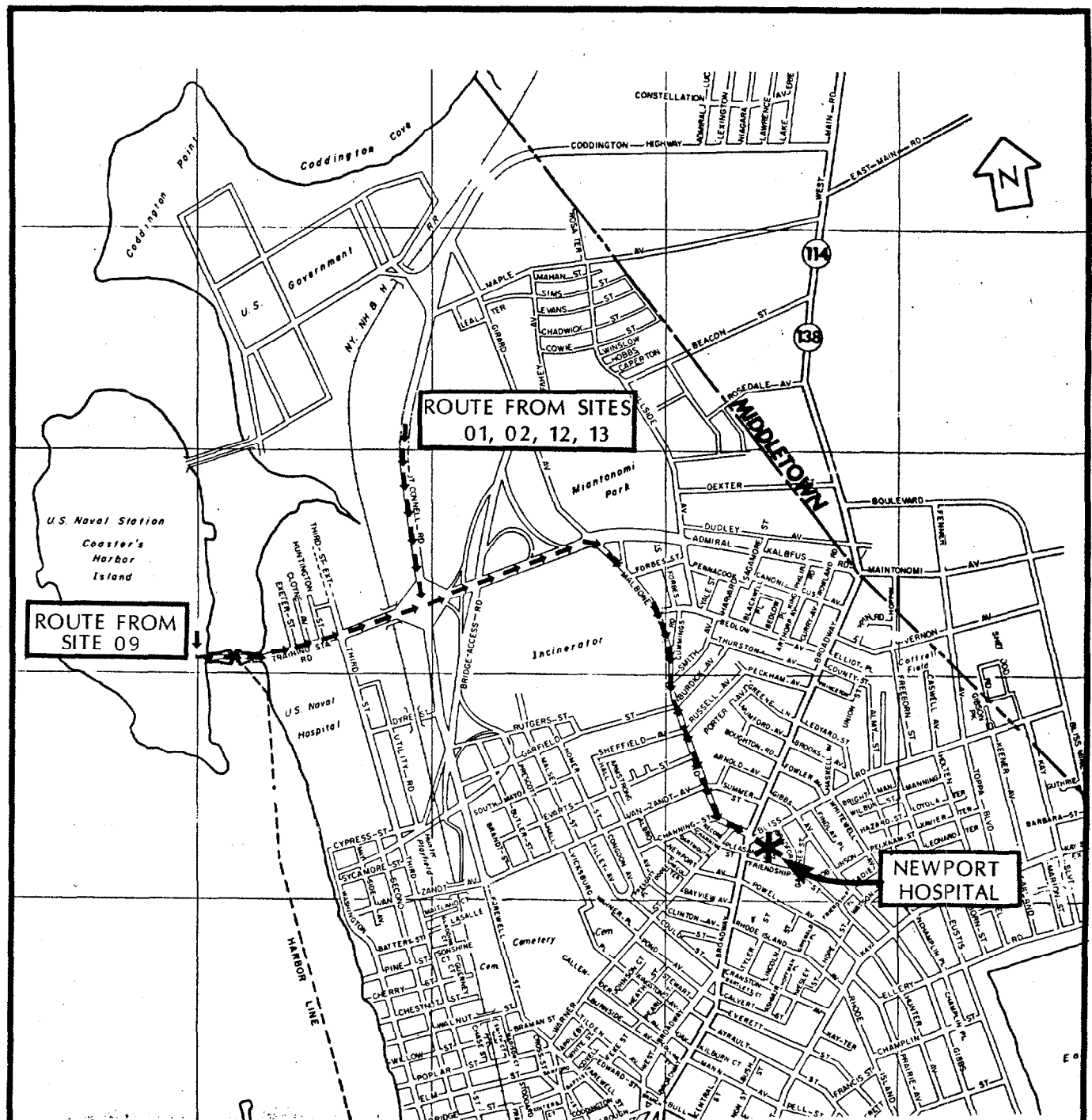
800 Connecticut Boulevard
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(203) 289-8631

NAVAL EDUCATION TRAINING CENTER NEWPORT, RI

FIGURE 2.

PERSONNEL ORGANIZATIONAL
STRUCTURE FOR HEALTH AND
SAFETY PROGRAM





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NAVAL EDUCATION TRAINING CENTER NEWPORT, RI

FIGURE 4.

NEWPORT HOSPITAL ROUTE MAP

ACCIDENT REPORT

Report No. _____

SITE: _____ PROJECT NO.: _____

Location: _____

Date of Report: _____ Preparers Name: _____

Name and Address of Injured: _____ SSN: _____ Age: _____

Sex: _____

Years of Service: _____ Time on Present Job: _____ Title/Classification: _____

Division/Department: _____ Date of Accident: _____ Time: _____

Accident Category: ☐ Motor Vehicle ☐ Property Damage ☐ Fire
☐ Chemical Exposure ☐ Near Miss ☐ Other

Severity of Injury or Illness: ☐ Non-disabling ☐ Disabling
☐ Medical Treatment ☐ Fatality

Amount of Damage: \$ _____ Property Damaged: _____

Estimated Number of Days Away from Job: _____

Nature of Injury or Illness: _____

CLASSIFICATION OF INJURY:

<input type="checkbox"/> Fractures	<input type="checkbox"/> Heat Burns	<input type="checkbox"/> Cold Exposure
<input type="checkbox"/> Dislocations	<input type="checkbox"/> Chemical Burns	<input type="checkbox"/> Frostbite
<input type="checkbox"/> Sprains	<input type="checkbox"/> Radiation Burns	<input type="checkbox"/> Heat Stroke
<input type="checkbox"/> Abrasions	<input type="checkbox"/> Bruises	<input type="checkbox"/> Heat Exhaustion
<input type="checkbox"/> Lacerations	<input type="checkbox"/> Blisters	<input type="checkbox"/> Concussion
<input type="checkbox"/> Punctures	<input type="checkbox"/> Toxic Respiratory Exposure	<input type="checkbox"/> Faint/Dizziness
<input type="checkbox"/> Bites	<input type="checkbox"/> Toxic Ingestion	<input type="checkbox"/> Toxic Respiratory
		<input type="checkbox"/> Dermal Allergy

Part of Body Affected: _____

Degree of Disability: _____

FIGURE 5. TRC ACCIDENT REPORT FORM (1 of 3)

Date Medial Care was Received: _____

Where Medical Care was Received: _____

Address (if off-site): _____

ACCIDENT LOCATION:

Causative agent most directly related to accident (Object, substance, material, machinery, equipment, conditions):

Was weather a factor: _____

Unsafe mechanical/physical/environmental condition at time of accident (Be specific):

Unsafe act by injured and/or others contributing to the accident (Be specific, must be answered):

Personal factors (Improper attitude, lack of knowledge of skill, slow reaction, fatigue):

Level of personal protection equipment required in Site Safety Plan: _____

Modifications: _____

Was injured using required equipment: _____

If not, how did actual equipment use differ from plan: _____

What can be done to prevent a recurrence of this type of accident (Modification of machine; mechanical guards; correct environment; training):

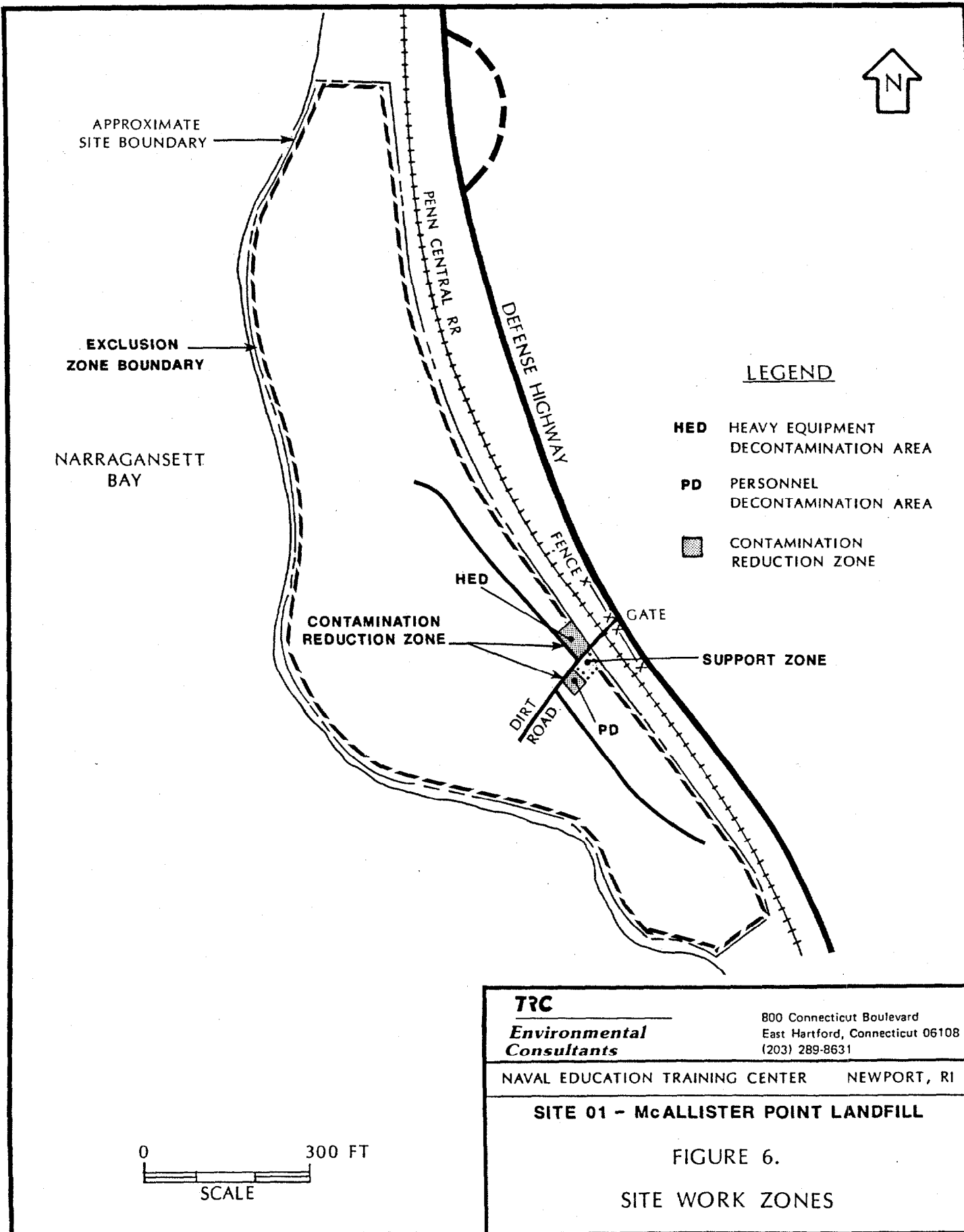
Detailed narrative description (How did accident occur, why; objects, equipment, tools used, circumstance assigned duties) (Be specific):

(Use back of sheet, as required)

Witnesses to accident: _____

Signature of Preparer _____

Signature of Site Leader _____



TRC

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NAVAL EDUCATION TRAINING CENTER NEWPORT, RI

SITE 01 - McALLISTER POINT LANDFILL

FIGURE 6.

SITE WORK ZONES

